Final EIS

Final Environmental Impact Statement

Integrated Pest Management

Walter H. Horning Seed Orchard
Colton (Clackamas County), OR

BLM
SALEM DISTRICT
JUNE 2005

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

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BLM/OR/WA/PL-04/015-1792

Photographs on Cover:

Unit C07: Mature Douglas-fir

Greenhouse 1

Unit B91 Twelve year old rust resistant sugar pine orchard in the foreground with E07 Grafted Douglas-fir and C07 Seedling Seed Orchard in the background.

Grassy area in Section 23, with Douglas-fir orchards in background.

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Salem District Office
1717 Fabry Road S.E.
Salem, Oregon 97306

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

Dear Reader:

Attached is the final environmental impact statement (EIS) for a proposed integrated pest management (IPM) program at BLM's Horning Seed Orchard, located in Colton, Oregon, in Clackamas County. The proposed IPM program will manage the insect, weed, animal, and disease problems at Horning, and maintain healthy, vigorous crop trees and other plants for the production of seed and other vegetative materials, which are used primarily for reforestation and a variety of land management activities. This EIS analyzes the potential impacts of the proposed action and alternatives, and will be used in the development of the IPM program at Horning.

The *National Environmental Policy Act* requires BLM to assess the potential environmental impacts of the proposed action and alternatives, and to involve the public in its decision-making process. In accordance with Executive Order 12372, *Intergovernmental Review of Federal Programs*, BLM requested input from other Federal, state, and local agencies and from the public on the Draft EIS, which was published in June 2003, as announced in the *Federal Register* [68(124):38324] on June 27, 2003. BLM received three comment letters on the Draft EIS, which are addressed in this Final EIS. No comments were submitted during the public meeting that was held at the seed orchard on July 17, 2003.

The Environmental Protection Agency (EPA) will publish a notice of the availability of this Final EIS in the *Federal Register*. Following the 30-day availability period that begins with publication of EPA's *Federal Register* notice, BLM will issue a Record of Decision (ROD) announcing selection of the alternative to be implemented. Any comments you wish to submit during this 30-day availability period should be mailed, faxed, or e-mailed directly to:

Mr. Jeffrey Gordon, Supervisor
Terry Garren, Horticulturist
Horning Seed Orchard
27004 S. Sheckly Road
Colton, OR 97017
Fax: (503) 630-6888
E-mail: oripmeis@blm.gov

This forest management decision may be protested under 43 CFR 5003 - Administrative Remedies. In accordance with 43 CFR 5003.2, the decision for this project will not be subject to protest until the notice of availability of the ROD is first published in the *Federal Register* by EPA, approximately 30 days after the notice of availability of this Final EIS. Protests of the decision must be filed with this office within 15 days after newspaper publication of the notice of availability of the ROD. If no protest is received by the close of business (4:15 p.m. Pacific Standard Time) on the 15th day, the decision will become final. If a timely protest is received, the decision will be reconsidered in light of the protest and other pertinent information available in accordance with 43 CFR 5003.3.

Sincerely,

Denis Williamson,
District Manager, Salem District

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Salem District Office
1717 Fabry Road SE
Salem, Oregon 97306

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Michelle Chester, Supervisor
Jerry Carney, Development
Horning Seed Orchard
[illegible] Shelby Road
Colton, OR [illegible]
Fax: (503) [illegible]
E-mail: [illegible]

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Sincerely,

[illegible]
District Manager, Salem District

Final Environmental Impact Statement:
Integrated Pest Management Program, BLM Horning Seed Orchard
Colton, Clackamas County, Oregon

Agency:
Bureau of Land Management
Horning Seed Orchard
27004 S. Sheckly Road
Colton, OR 97017
E-mail: oripmeis@blm.gov
Fax: (503) 630-6888

For Further Information Contact:
Mr. Jeffrey Gordon, Supervisor
Terry Garren, Horticulturist
Horning Seed Orchard
27004 S. Sheckly Road
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E-mail: oripmeis@blm.gov
Telephone: (503) 630-8405

Designation: Final Environmental Impact Statement (EIS)

Privacy Advisory

Any comments on this Final EIS are requested by 30 days after the notice of availability is published. In accordance with the Privacy Act, individuals (but not organizations and businesses) may request their name be withheld from public review by stating this request at the beginning of their letter.

Abstract

The Bureau of Land Management (BLM) is proposing to implement an integrated pest management (IPM) program at Walter H. Horning Seed Orchard. In compliance with the *National Environmental Policy Act* (NEPA) of 1969, BLM has prepared this environmental impact statement (EIS), which assesses four action alternatives and the no action alternative:

- **Alternative A Maximum Production IPM**. Pests would be managed using all identified biological, chemical, prescribed fire, cultural, and other pest control methods, including aerial esfenvalerate application by helicopter.
- **Alternative B—IPM with Environmental Protection Emphasis (Proposed Action).** Pests would be managed using all of the methods in Alternative A, with limitations designed to protect worker health and safety and the environment. The limitations are based on the conclusions of a recent risk assessment, scoping comments, and recommendations from BLM interdisciplinary team members.
- **Alternative C—Ground-Based IPM.** This alternative is identical to Alternative B except for the exclusion of helicopter applications.
- **Alternative D—Non-Pesticide Pest Management.** Pests would be managed using only the non-pesticide biological, prescribed fire, cultural, and other methods listed under Alternative A. No biological or chemical pesticides would be permitted.
- **Alternative E—No Action: Continuation of Current Management Approach.** The current management system uses all non-chemical-pesticide pest control practices at the seed orchard, as well as chemical pesticides on a case-by-case basis. All biological, prescribed fire, cultural, and other methods would be used in accordance with current procedures. When a specific need is identified for a chemical pesticide, the action would be reviewed to determine whether it is encompassed by an existing NEPA document, or whether an environmental assessment or EIS is required.

Alternative B, the proposed action, is the preferred alternative of BLM.

Resources analyzed in the EIS include air quality, geology, water, land use, human health and safety, biological resources, noise, cultural resources, and socioeconomics and environmental justice. The EIS also assesses the potential cumulative effects of implementing the IPM program along with other actions occurring concurrently at Horning and in the surrounding area. The recently conducted risk assessment is included in the supporting record and summarized in an appendix.

Changes in Proposed Action from Draft EIS to Final EIS

- Use of the biological insecticide *B.t.* was removed from Alternative D, which was renamed "Non-Pesticide Pest Management."

- Imidacloprid, as a capsule implant, was added to the list of potential insecticides.

- The terms and conditions specified by NOAA Fisheries during *Endangered Species Act* consultation have been added to the list of limitations (Section 2.3.3) that are inherent to Alternative B, the proposed action.

- The monitoring plan (Appendix B) has been revised for consistency with the terms and conditions specified by NOAA Fisheries.

- Table 2.2-1, Pesticide and Fertilizer Application Summary, has been revised to increase the number of acres in the native plant beds on which propiconazole may be applied, due to expansion of the beds. Review of the increased in treated acreage compared to the results of the quantitative risk assessment indicate no effect on the human health or nontarget species risk conclusions of the risk assessment, and therefore no change in the potential for impacts from this pesticide between the Draft and Final EISs.

- Hand-held wick and injection were added to the list of pesticide application methods in Section 2.2.2.2, from which they had previously been inadvertently omitted, for consistency with Table 2.2-1 and the impact assessment details.

- Minor editorial changes were made throughout the document that did not affect the proposed action or the impact assessment.

Executive Summary

The U.S. Bureau of Land Management (BLM) proposes to implement an integrated pest management (IPM) program at the Walter H. Horning Seed Orchard (Horning) in Clackamas County, Oregon. The orchard is within BLM's Salem District. In accordance with the *National Environmental Policy Act* (NEPA) of 1969, as amended, which requires Federal agencies to consider environmental consequences in their decision-making process, this environmental impact statement (EIS) identifies potential environmental impacts from each alternative considered. This EIS must be prepared before BLM makes final decisions regarding the selection of an alternative, and be available to inform decision makers and the public of potential environmental consequences of the proposed action or an alternative. Distribution and review of the Draft EIS in June 2003 allowed for public consideration and input concerning the proposed IPM program. After carefully considering comments on the Draft EIS, BLM has made minor changes to the document, and is now issuing this Final EIS. After a 30-day availability period for the Final EIS, BLM will publicly state which action will be implemented in a formal document called a Record of Decision (ROD). Subsequent IPM activities will be implemented over the life of the IPM plan (usually 15 to 20 years) in accordance with that decision.

BLM will use the analyses presented in this EIS to decide how to continue operations at Horning in a manner consistent with human health and safety considerations and existing environmental protection laws, while maintaining adequate seed and seedling production. Maintaining adequate production includes the implementation of an IPM approach to manage vegetation, insects, disease, and animal pests at the seed orchard. The ROD to be issued on the basis of this EIS, by the BLM Salem District Manager, will identify the specific methods that will be available for use at Horning for controlling insects, disease, vegetation, and animal pests. No further NEPA documentation relating to IPM should be required before pest management projects are undertaken, unless the seed orchard manager proposes a new IPM product or technology that was not analyzed in this EIS.

Purpose and Need for Action

The purpose of the action is to manage insects, diseases, competing and unwanted vegetation, and animal pests at Horning. Management of adverse impacts from pests is necessary to allow the seed orchard to produce improved seed for conifer seedling production, preserve valuable individual conifer trees, produce native species plants and plant species seed, and produce containerized seedlings in a greenhouse nursery. This high-quality seed is supplied to BLM and other cooperators for reforestation and restoration projects.

For many years, Horning has managed pests with very limited use of chemicals: fenvalerate and esfenvalerate were used in the 1980s, 1990s, and in one application per year from 1999 through 2002 to control cone and seed insects in the orchard units, and several fungicides and insecticides were used in the greenhouse to control disease and insect pests. Each use in the orchard has required preparation of a separate NEPA document (an environmental assessment, or EA) to analyze the potential impacts from use of these chemicals. Changes and experience with control methods at Horning have created the need to re-evaluate the pest management program to ensure that the pest management objectives at Horning continue to be met. In addition, the public demand for efficient use of resources in government, as well as for providing appropriate environmental protection, requires the selection and use of the best pest management

techniques for efficient and cost-effective orchard operation over the long term. The pest management objectives at Horning include the following:

- Minimize insect damage to orchard trees, cone crops, native plants, and greenhouse seedlings.
- Remove noxious weeds and control vegetation that favors animal pests and disease conditions, and reduce fire hazard conditions.
- Reduce growth of vegetation to allow tree establishment and growth, and reduce the fire hazard.
- Treat fungal and bacterial diseases to maintain the health and vigor of the orchard trees used for seed production; and to control plant pathogens in the greenhouse and native seedling grow-out beds.
- Minimize animal damage to orchard trees, native plant beds, greenhouse seedlings, and orchard equipment and infrastructure.

The need for this action is demonstrated by research which was conducted in 1983 at 17 different seed orchards in the western U.S. This research indicated an overall loss of 70% of the filled seed as a result of cone insect pests. The loss at Horning was 76% of the total potential seed. The need for action is also demonstrated by the orchard's experience with periodic problems from insects, disease, weeds, and animals.

Pest Management Methods

There are many methods available to manage insects, disease, vegetation, and animal pests at Horning. These methods generally fall into the categories of biological, chemical, prescribed fire, cultural, and other methods.

The pest management methods that are analyzed under one or more of the alternatives in this EIS are as follows:

Biological Control

- Vegetation: grazing cooperators place their cattle in the orchard units to remove grasses (this method has been used in the past and will be considered again in the future); planting fallow crops or certain cover crops in rows between orchard trees to limit growth of undesirable vegetation and noxious weeds.
- Insects: bird and bat boxes to attract insect-eating birds and bats, naturally occurring bacteria such as *Bacillus thuringiensis* (a biological insecticide), predator mites and nematodes, lady bugs, and aphid lions.
- Animal pests: predators including coyote, fox, and cougar are present and encouraged to frequent the seed orchard grounds to aid in the control of animal pests.

Chemical Pesticides

- Vegetation: herbicides, including dicamba, glyphosate, hexazinone, picloram, and triclopyr.
- Insects: insecticides, including acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, horticultural oil, imidacloprid, permethrin, propargite, and Safer® soap.

- Disease: fungicides, including chlorothalonil, hydrogen dioxide (in greenhouse only), mancozeb (in greenhouse only), propiconazole, thiophanate-methyl (in greenhouse only), and dazomet (a soil fumigant).

The methods that may be used to apply these pesticides at Horning are aerial (helicopter) for esfenvalerate only, airblast sprayer, high-pressure hydraulic sprayer, hydraulic sprayer with hand-held wand, tractor-pulled spray rig with boom, backpack sprayer, capsule implantation, granular spreaders, hand sprayer, chemigation, and total-release canister.

Note that not all chemicals would be used in a given year, and some might never be used. However, their analysis in an alternative in this EIS, and subsequent selection of that alternative in the ROD, would give the seed orchard manager the option of using them in the future should a specific need arise. It is also important to note that each chemical application must first be approved by the Horning seed orchard manager. All pesticides would be applied in compliance with all Federal and Oregon state laws, BLM regulations and policies, and manufacturer recommendations.

Prescribed Fire

- Vegetation: propane-fueled flame wands for vegetation removal in native plant beds prior to planting, small patches of underburning in orchard units, pile burning of cut/cleared vegetation, pile burning of spent sugar pine cones.

- Disease: burning grass straw in bed rows in the native plant gardens.

Cultural Control Methods

- Vegetation: hand-pulling, non-powered and powered hand tools to cut and clear, tractors with various blade attachments for mowing, gasoline-powered string trimmers, tilling an unvegetated buffer around native plant beds, mulch mats.

- Disease: pruning, thinning, stump grinding; in greenhouse, knocking or blowing water off seedlings and control of air flow through the use of fans and convection tubes.

- Animal pests: trapping of gophers, porcupines, and other small mammals; fencing that excludes deer and elk from orchard, Vexar tubes to protect seedlings, use of sticky traps in greenhouse, screening to exclude squirrels from seed extractory and cone shed.

Other Methods

- Pheromone bait traps for insects.

- Fertilization to promote overall tree health, cone production, and disease resistance.

It is the policy of the Department of the Interior, and all of its agencies including BLM, to use chemical pesticides only after considering the alternatives; and to develop, support, and adopt IPM strategies wherever practicable.

The focus of IPM is on long-term prevention or suppression of pests. The integrated approach to pest management incorporates the best-suited biological, chemical, and cultural controls that have minimum impact on the environment and on people. IPM is not pesticide-free management; however, a successful IPM program should result in the most efficient use of pesticides if and when they are needed.

Research into better and more effective control methods is also an essential part of an IPM program. The seed orchard manager would regularly review the pest management methods available for use, including new and developing technologies, to ensure that the seed orchard utilizes the most effective methods of control while minimizing the potential for any adverse environmental or health impacts.

The focus of this EIS is on activities directly relating to implementing an IPM program at Horning. Other routine management actions—such as establishment and maintenance of orchard units, buffer zone management, and facilities/equipment maintenance—are not directly related to IPM and therefore not evaluated in this EIS.

Alternatives

BLM identified and evaluated five alternatives to address the need for a pest management program at Horning, as follows:

- Alternative A: Maximum Production IPM
- Alternative B: IPM with Environmental Protection Emphasis (Proposed Action)
- Alternative C: Ground-Based IPM
- Alternative D: Non-Pesticide Pest Management
- Alternative E: No Action—Continue Current Management Approach

Alternative B is BLM's preferred alternative. Each alternative is described in more detail below.

Pest management methods that are common to all alternatives are biological methods, cultural methods, prescribed burning, and other non-pesticide control methods. Other activities common to all alternatives include orchard management activities unrelated to pest management and protection measures that would be observed under any alternative. Protection measures are a list of "best management practices" intended to ensure the proper and safe application of pesticides at Horning and include worker protection measures as well as public, environmental, and ecological protection measures.

Alternative A—Maximum Production IPM

Under this alternative, the primary goal is the maximum production of seeds and plants with a very low level of acceptable losses. Horning's seed orchard manager would have all identified biological, chemical, prescribed fire, cultural, and other pest control methods available for use. An effective IPM strategy for all orchard pests would be implemented under this alternative; however, the primary management objective would be to maximize seed production for annual BLM and cooperator seed needs by aggressively controlling cone and seed insects and other limiting factors. The most effective insect control measures would be implemented, to maximize seed yield and reduce damage to the seed crops with low acceptable seed losses, emphasizing production above other less-effective control methods and considerations, with a low threshold for initiating treatment.

Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Under this alternative, the seed orchard manager would have access to the full list of pest management methods identified above; however, chemical use would be restricted by a set of limitations. These limitations address risks predicted by the quantitative risk assessment, respond to scoping concerns, consider the results of previous monitoring,

and include recommendations made by the interdisciplinary EIS preparation team. The limitations provide added protection to human health and the environment, and distinguish the details of potential treatments under Alternative B from those under Alternative A. The complete list of limitations is provided in Section 2.3.3.

Alternative C—Ground-Based IPM

Alternative C would be identical to Alternative B, except that the option to apply esfenvalerate by helicopter would be eliminated.

Alternative D—Non-Pesticide Pest Management

Alternative D would allow the seed orchard manager to use only the non-pesticide biological, prescribed fire, cultural, and other methods listed above. No biological or chemical pesticides would be permitted.

Alternative E—No Action: Continue Current Management Approach

Alternative E would allow continuation of the current management system, which is the use of all non-pesticide control practices at the seed orchard, as well as the use of pesticides on a specific case-by-case basis. All biological, prescribed fire, cultural, and other non-pesticide methods would be used as needed. When a specific need is identified for a pesticide, the action would be reviewed to determine whether it is encompassed by an existing EA or EIS. This could include applications for controlling cone insects or other orchard insect outbreaks, disease infestations, and any vegetation control necessary that is not covered by other BLM vegetation control NEPA documents.

Alternative Considered But Not Further Analyzed

During the scoping process, one member of the public suggested planting more crop trees than necessary to allow for some loss to pests, which was interpreted as a request to consider no pest management at all. This is not a viable alternative for several reasons. First, this approach could lead to a significant loss of the crop trees in the production units if disease were to occur. Secondly, orchard research has shown that approximately 70% of the seed crop could be lost if no pest management were practiced. To partially offset the effects of cone and seed insects and decreased tree vigor due to disease, it would be necessary to plant production trees in fields that are currently fallow, as the commentor suggested. This solution would require the seed orchard and their cooperators to accept an estimated 10-year reduction in seed production, which is the time that would be required for the newly planted trees to produce collectable seed. This decrease in production could also result in delays in reforestation projects caused by potential seed shortages, or reduced forest growth resulting from the use of genetically inferior seed from other sources. In addition, a more intensive planting regime on seed orchard grounds, with no pest management of any kind, would allow the orchard lands to become a "reservoir" for insects, disease, noxious weeds, and animal pests that would spread to neighboring public and private lands—effectively, becoming a threat and nuisance to the neighbors, particularly those who cultivate crops of their own.

Affected Environment

Horning is located approximately 23 miles southeast of the city of Portland and 40 miles north-northeast of Salem, Oregon, near the small community of Colton and within Clackamas County. The town of Estacada is about 8 miles northeast of the orchard.

Horning lies within the Willamette River valley, between the Oregon Coast Range and the Cascade Mountains. Its geographical location between the Pacific Ocean and Cascade Mountains results in a maritime west coast climate, featuring mild, wet winters and cool, dry summers. Horning is located on the watershed divide between the Clackamas River and Molalla River in the Willamette River basin.

The EIS includes a detailed discussion of the relevant environment at Horning, providing baseline information for evaluating potential environmental impacts that could result from the proposed action or an alternative action. The human environment includes natural and physical resources and the relationship of people to those resources.

The resources described in the EIS include, in order of presentation, the physical environment (air, geology, and water), followed by land use, human health, biological resources, and the human environment (noise, cultural resources, socioeconomics, and environmental justice). These resources are described in a sufficient level of detail to adequately support the impact analysis.

Environmental Impacts

Chapter 4 of the EIS details the methods of analysis and assumptions made in evaluating potential impacts to each resource. Approaches included conducting a quantitative human health and ecological (non-target species) risk assessment (summarized in Appendix C), environmental fate and transport modeling, literature review, statistical evaluations, and review of similar actions at other locations. The resource-specific subsections in Chapter 4 describe the methods and present the criteria used for determining whether there are any potential impacts.

The analysis predicted no significant impacts to air quality, geology and soils, land use, noise, cultural resources, and socioeconomics and environmental justice. Human health, biological resources, and surface water (as it relates to aquatic species) are the resources with the greatest potential for impact and are therefore of greatest concern for decision-making:

Human Health and Safety

- There are no significant risks to members of the public from the proposed use of any of the control methods under any of the alternatives. However, under Alternatives A, B, C, and E, an accidental spill of pesticide to a stream could make surface water unsafe for drinking or fishing. Under Alternatives B and C, the probability of any accidental spill to surface water would be decreased by limits on pesticide transport over specific streams.

- Under Alternatives A and E, there is a possibility of health effects for workers from some chemical pesticides. No risks of worker health effects were predicted for pesticide applications under Alternatives B and C. Under Alternatives A, B, C, and E, an accidental spill onto the skin could cause health risks. Under all of the alternatives, there is a possibility of injury from cultural or prescribed fire methods.

Water Quality

- No significant impacts to groundwater quality were predicted under any alternative.

- Runoff or drift from pesticide applications could enter streams and rivers under Alternatives A, B, C, and E, as could runoff containing fertilizers under all alternatives. The effects of the estimated stream concentrations on human health and aquatic

species are described under those headings. Under Alternatives B and C, limitations would be in place to control the potential for runoff and drift.

- An accidental spill of pesticide concentrate or mix could contaminate groundwater or surface water under Alternatives A, B, C, and E. Under Alternatives B and C, the probability of any accidental spill to surface water would be decreased by limits on pesticide transport over specific streams.

Biological Resources

- No significant adverse impacts to non-target vegetation are expected under any of the alternatives.
- There are possible risks to terrestrial wildlife species from three of the proposed insecticides under Alternatives A and E, and from calcium nitrate fertilizer under all alternatives. Lethality would be expected for non-target insects in an area treated with insecticide under Alternatives A, B, C, and E. With the exception of localized lethal impacts to non-target insects, no significant impacts to terrestrial wildlife were predicted under Alternatives B and C.
- There are no significant risks to aquatic species from use of chemical, biological, prescribed fire, or cultural control methods under any of the alternatives. Under Alternatives A, D, and E, there is a potential for sublethal impacts due to ammonium toxicity on special status aquatic species under maximum scenario conditions only. Under Alternatives A, B, C, and E, there could be adverse impacts to aquatic species from an accidental spill of pesticide to a stream. Under Alternatives B and C, the probability of any accidental spill to surface water would be decreased by limits on pesticide transport over specific streams.

Alternative B is the proposed action, and is BLM's preferred alternative for minimizing long-term impacts to all resources, including human health.

Cumulative Impacts

According to CEQ regulations at 40 CFR 1508.7, "cumulative impact" is the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions. There are no other major projects proposed in the orchard vicinity that are long-term in nature or would result in significant changes in the physical characteristics of the project area. Another cumulative concern relates to the potential toxic effects of exposure to multiple chemicals. The human health risk assessment addressed cumulative risk to workers and the public from the subset of proposed chemicals that are more likely than others to be used in a given year. No risk was identified for members of the public, but risk was identified for some workers under Alternative A when very conservative assumptions were applied to avoid underestimating the potential impact.

Mitigation Measures

Based on the results of the quantitative risk assessment, the selection of Alternative A, Maximum Production IPM, could result in environmental impacts to human health and biological resources. Therefore, CEQ's regulations for implementing NEPA require that potential mitigation measures for these consequences be identified in this EIS. The identified mitigation measures, described in detail in Section 4.12, restrict rates, frequencies, and other use details for diazinon, dimethoate, dicamba, hexazinone, mancozeb, and fertilizers.

BLM's proposed action: Alternative B, IPM with Environmental Protection Emphasis, and the limitations incorporated into it (see Section 2.3.3 of the EIS), are expected to address all potential risks identified in the EIS and risk assessment. During the ESA consultation process, NOAA Fisheries identified additional terms and conditions to provide additional protection to threatened steelhead trout and chinook salmon. These requirements are listed in Section 2.3.3 of this Final EIS.

Alternative C, Ground-Based IPM, incorporates the limitations inherent to Alternative B, so no mitigation measures were identified; this alternative was not included in the ESA consultation process.

No significant impacts were associated with Alternative D, Non-Pesticide Pest Management, so identification of mitigation measures is not required.

Mitigation measures for use of chemical pesticides under Alternative E, No Action, would be identified on a project-by-project basis during the specific NEPA assessments.

The ROD that will be published at the conclusion of the EIS process will specify the mitigation measures that will be implemented with the selected alternative.

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Chapter 4

Tables

1.0 Introduction

The U.S. Bureau of Land Management (BLM) proposes to implement an integrated pest management (IPM) program at the Walter H. Horning Seed Orchard (Horning) in Clackamas County, Oregon. The orchard is within BLM's Salem District. The *National Environmental Policy Act* (NEPA) of 1969, as amended, requires Federal agencies to consider environmental consequences in their decision-making process. The President's Council on Environmental Quality (CEQ) has issued regulations to implement NEPA that include provisions for both the content and procedural aspects of the required environmental analysis (40 Code of Federal Regulations (CFR) 1500 et seq.). The environmental impact analysis process, as governed by the Department of the Interior's Departmental Manual 516, *NEPA Compliance*, and BLM's Manual H-1790-1, *National Environmental Policy Act Handbook*, is the mechanism by which BLM ensures its decisions are based on an understanding of potential environmental consequences. The CEQ regulations were used in conjunction with the Departmental and Bureau guidance to determine the appropriate level of environmental analysis for this action, which BLM has determined to be an Environmental Impact Statement (EIS).

Preparation of this EIS must precede final decisions regarding the selection of an alternative, and be available to inform decision makers and the public of potential environmental consequences. A Notice of Intent was originally published in the Federal Register (FR) on March 26, 1999 (64 FR 14747), and announced BLM's intent to prepare one consolidated EIS for all four Oregon seed orchards. A Revised Notice of Intent was published on March 29, 2001 (66 FR 17192) to announce BLM's revised intent to prepare three separate EISs for the four seed orchards, with each EIS being District-specific and the Medford District EIS including both the Sprague and Provolt Seed Orchards. Distribution and review of the Draft EIS in June 2003 allowed for public consideration and input concerning the proposed IPM program, and provided to decision makers and the public the information required to understand the future environmental consequences of the proposed action or an alternative. After carefully considering comments on the Draft EIS, BLM is now issuing this Final EIS. After a 30-day availability period for the Final EIS, BLM will publicly state which action will be implemented in a formal document called a Record of Decision (ROD). Subsequent IPM activities will be implemented over the life of the IPM plan (usually 15 to 20 years) in accordance with that decision. No further NEPA documentation relating to IPM would be required, unless the seed orchard manager proposes to use a new IPM product or technology that was not included in the alternative selected in the ROD. The NEPA review requirements in this situation are discussed in Section 2.4.4.

This introductory chapter identifies the purpose and need for action, provides a general description of the location of the seed orchard, summarizes scoping comments and issues, and discusses the relationship of this document to other plans, policies, and programs. It concludes by describing the organization of the remainder of this EIS.

1.1 Purpose and Need for Action

1.1.1 Purpose of Action

The purpose of the action is to manage competing and unwanted vegetation, diseases, insects, and animal pests at Horning. Management of adverse impacts from pests is necessary to allow the seed orchard to produce improved seed for conifer seedling production, preserve individual valuable conifer trees, produce native species plants and plant species seed (including grass, forb, brush, and other), and produce containerized seedlings in a greenhouse nursery. This high-quality seed is supplied to BLM and other cooperators for reforestation and restoration projects.

For many years, Horning has managed pests using an IPM program that included limited use of chemicals: fenvalerate and esfenvalerate were used in the 1980s, 1990s, and in one application per year from 1999 through 2002 to control cone and seed insects in the orchard units, and several fungicides and insecticides were used in the greenhouses to control disease and insect pests. Each use in the orchard has required a separate NEPA document (an environmental assessment, or EA) to analyze the potential impacts from use of these chemicals. Changes and experience with control methods at Horning have created the need to re-evaluate the pest management program to ensure that the pest management objectives at the seed orchard continue to be met. In addition, the public demand for efficient use of resources in government, as well as for providing appropriate environmental protection, requires the selection and use of the best pest management techniques for efficient and cost-effective orchard operation over the long term. The pest management objectives at Horning include the following:

- Minimize insect damage to orchard trees, cone crops, native plants, and greenhouse seedlings.
- Remove noxious weeds and control vegetation that favors animal pests and disease conditions, and reduce fire hazard conditions.
- Reduce growth of vegetation to allow tree establishment and growth and to minimize damage to orchard equipment and infrastructure.
- Treat fungal and bacterial diseases to maintain the health and vigor of the orchard trees used for seed production and to control plant pathogens in the greenhouse and native seedling grow-out beds.
- Minimize animal damage to orchard trees, native plant beds, greenhouse seedlings, and orchard equipment and infrastructure.

1.1.2 Need for Action

The need for this action is demonstrated by research which was conducted in 1983 at 17 different seed orchards in the western U.S. This research indicated an overall loss of 70% of the filled seed as a result of cone insect pests. The loss at Horning was 76% of the total potential seed. The need for action is also demonstrated by Horning's experience with periodic problems in the orchard units and greenhouses from insects, disease, weeds, and animals. These pests are described in the following paragraphs. Appendix A contains detailed information on the more common and damaging insects and diseases at Horning.

1.1.2.1 Insects

Many insects known to be capable of causing serious injury to Douglas-fir, pines, and other orchard species are present in the lands in and near the orchard. These include Douglas-fir cone gall midge (*Contarina oregonensis*), Douglas-fir cone worm (*Dioryctria* spp.), Douglas-fir cone moth (*Barbara colfaxiana*), seed bug (*Leptoglossus occidentalis*), Douglas-fir seed chalcid (*Megastigmus spermotrophus*), and western redcedar gall midge (*Phytophaga thuja*).

Most types of detrimental insects cause limited amounts of tree damage, including stress; deformation of tree stem, roots, branches, needles, or buds; damage to pollen, cones, and seeds; and mortality. Generally, the adult insects lay eggs on trees. The larval stages of these insects then tunnel into tree parts and eat tissue, destroying or deforming the tree parts, or the adult insect will bore into seeds to remove the contents. Larvae will often form pupae in or on the tree parts, such as in the bark or cones, and overwinter until the following spring when they emerge as adults, thus completing the life cycle.

Healthy vigorous trees are able to withstand occasional or limited attacks of foliar, bark, or root insects and recover with little damage. However, large numbers of cone and seed insects are present in the orchards every year and, under the correct conditions, are capable of causing heavy damage to seed crops. A variety of control measures can generally limit the effects of most insects to minor or acceptable amounts of damage. The exceptions are cone and seed insects, and insect population bursts and very localized small outbreaks of other insects. Also, insect populations will slowly increase in the orchards and surrounding areas as the trees become older and produce more cones (due to a slow building and survival of these insect populations), increasing the risk of population bursts and resulting damage.

Insects have destroyed 60 to 100% of the seed crop in Douglas-fir seed production orchards. Similar infestations have resulted in severe insect damage in Douglas-fir breeding and preservation orchards.

Currently, endemic insect populations have not posed a severe threat to cone seed production in the western hemlock, and western redcedar production orchards. In the future, if insect populations increase, losses may reach unacceptable levels and trigger a need for pest management.

The sugar pine and western white pine orchards have not reached cone production age. Within two to four years, they should reach maturation and be producing viable cone crops. As this begins, insects are expected to reduce crop potential at a rate of 20 to 60%, consistent with losses experienced by other pine seed orchards within the region.

Infestations by insects such as aphids, leaf hoppers, bark beetles, grasshoppers, sawflies, scales, mites, hemlock woolly adelgids, and defoliating caterpillars are relatively infrequent, and usually below threshold levels that pose a significant threat. However, they have the capacity to cause significant damage should their populations increase to high levels, such as has occurred in other geographic areas.

Greenhouse insect pests that occasionally require control include aphids, leafrollers, needleminers, fungus gnats, and root weevils.

1.1.2.2 Disease

Because of Horning's location on old forest lands, some pathogens common to local Douglas-fir forest stands have been identified in the seed orchard, including *Armillaria* root rot (*Armillaria* spp.), annosus root rot (*Fomes annosus*), laminated root rot (*Phellinus weirii*), *Phytophthora* root rot (*Phytophthora crytogea*), and black stain root rot (*Leptographium wageneri*). Tree stumps have been treated with Tim-bor® (a borate compound), which controls some of these diseases, so no significant effect on the orchards is anticipated in the near term. In trees under 40 years of age, such as those at Horning, these soil-borne diseases are more passive and slow to result in symptoms that would affect tree growth. The practice of stump removal during clearing and within the orchards leaves little potential for root diseases to advance.

Foliar diseases have also had little impact on orchard trees to date. A few outbreaks of *Phomopsis* canker (*Phomopsis occulta*) and needlecasts (*Rhabdocline pseudotsugae* and *Phaeocryptopus gaumanni*) have caused some needle loss and stem damage to trees. Other minor foliar diseases include Douglas-fir rust (*Melampsora occidentalis*) and rusts in the western white pine and sugar pine orchards. The trees planted in these orchards were selected based on levels of blister rust resistance and so far have displayed only slight damage. Western gall rust (*Endocronartium harknessii*) and white pine blister rust (*Cronartium ribicola*) have been noted in local orchards, but are not expected to cause major problems at Horning due to the trees' disease resistance.

Because of the overall good health and vigor of the seed orchard trees, it is expected that these diseases would usually cause only minor damage such as needle loss, and branch and stem loss or deformation. However, if future conditions change and environmental stresses occur, these diseases could cause significant problems to valuable orchard trees.

In the greenhouse, the main diseases of concern are seed-borne and foliar diseases. The wide range of native conifers, grasses, shrubs, and hardwoods present in the greenhouse is associated with a greater potential for various disease problems. Some of the more prominent diseases identified in the greenhouse include grey mold (*Botrytis cinerea*); *Fusarium roseum*, *F. solani*, and *F. oxysporum*; *Cylindrosporium* leaf spot and stem canker; *Phomopsis* blight; *Anthracnose* leaf spot; *Alternaria* leaf spot; and *Lophodermium* needle cast. *Rhizoctonia*, *Pythium* spp., and *Phytophthora* spp. can also create problems in susceptible plants under stressed environmental conditions.

1.1.2.3 Vegetation

Undesirable vegetation (grasses, forbs, brush, and small and large trees, including invasive and exotic species of many kinds) grows in orchard units and native species beds; along fence lines, ditches, and roads; around developed areas such as structures and parking lots; and on fallow lands.

Unwanted woody hardwood and conifer tree and shrub species grow from sprouts or seeds in border or edge areas along fence lines and roads or in fallow areas. Blackberry species, black cottonwood, red alder, cedars, sedges, scotch broom, willows, and poison oak often create hazards or impediments to normal orchard operations. In addition, plants such as Canada thistle, tansy ragwort, knot weed, and others are noxious weeds requiring control. Other vegetation introduces contaminating "weed" seed into pure native plant seed beds, affecting the quality of the source seed being produced.

Unwanted and uncontrolled vegetation provides fuels for potential wildfires. Horning is in a rural environment surrounded by farms and homes with acreage. The risk of wildfire in the interface of orchard with public roads and homes is very high. The control of vegetation height in the orchard units, fallow open land areas, and borders is essential to reduce the rapid spread of grass fires.

Competition for water, nutrients, and light among the orchard trees, and cover crop vegetation in the orchard units, occurs during the active growing season. Reduction of vegetation increases available soil moisture and nutrients to the trees. Unwanted and uncontrolled vegetation near orchard trees is also a physical barrier to efficient spray patterns from sprinklers and micro jet emitters, and to safe and efficient foot and vehicular travel.

Uncontrolled vegetation also provides protective hiding and nesting cover for rodents and other animals which cause damage to orchard trees, building foundations, road surfaces, and the surface lands in the orchard units. Rodents chew and eat tree roots and bark, and sometimes eat foliage; chew and damage electrical wiring; burrow under concrete foundations, undermining building integrity; and burrow into roadways and throughout orchard units, causing erosion, degradation, and an uneven surface. Any uneven surface, in turn, creates a safety hazard when using ladders, high lifts, utility vehicles, or all-terrain vehicles. Keeping vegetation low reduces animal cover and increases the opportunity for predation on these animals by raptors and carnivores, thereby reducing the damage.

Because the eight-foot tall perimeter fences surrounding the orchard represent a very high capital investment, vegetation has been controlled along these fence lines. If left uncontrolled, this vegetation would ultimately overgrow and affect the structural integrity of these fences and their ability to act as barriers.

1.1.2.4 Animal Pests

A broad range of animal habitat exists in and around the seed orchard, including grass- and tree-covered orchard units, open grass-covered fallow areas, open woodlots, brushy hedgerows and edge areas, fence lines, year-round and intermittent stream courses, riparian areas, culverts, ponds, and roadsides. These habitats attract a wide mixed variety of animal life which lives and feeds on the orchard grounds.

Animals at Horning that may require control to minimize damage to seeds, trees, plants, and equipment include deer, elk, rabbits, voles, porcupines, mountain beavers, opossum, domestic dogs, fox, skunk, raccoon, ground squirrels, coyotes, mice, rats, and moles.

The 11.2 miles of eight-foot high woven wire fence at Horning excludes big game from the orchard. The fences are essential for keeping deer, elk, and stray livestock from small tender seedlings and grafted trees, as well as expensive graft-compatible rootstock. As the trees grow out of browsing reach from the deer, the fence continues to be an important deterrent to deer from doing antler damage to tree stems and to any other large animals from doing damage to the trees or irrigation system.

Rodents such as the western pocket gopher, deer mouse, and a variety of other mice and voles all cause damage to young tree roots and lower stems by eating plant tissue. Older trees can be damaged by porcupines, which eat inner bark tissue and girdle the tree stem. At Horning, porcupines caused serious damage to several orchard units in the early 1990s, until the animals were trapped and relocated. Ground squirrels tunnel around the foundations of buildings, in and near roads, and in the orchard lands, creating hazards to facilities and people.

Other animals cause damage to portions of the irrigation systems (1-inch poly supply line, ½-inch poly supply line, and drip emitters). The coyote, gray and red foxes, opossum, striped and spotted skunk, raccoon, domestic dogs, and some of the rodents listed above chew off and remove, or chew holes in, the irrigation system parts, which causes leaks and water loss, requires time and money to repair, and prevents the trees from getting water.

At Horning, the Douglas squirrel can cause damage and loss to cones on the trees. The squirrels come into the orchard units from adjacent woodlands or riparian areas to hunt for food, including the cones hanging on orchard trees in the pollen exclusion bags.

Some animals causing damage are also predators for other animals that damage orchard crops. Animals are generally welcome and accepted at Horning until populations rise, food preferences shift to orchard crops, or damage becomes unacceptable.

1.2 Location of Walter H. Horning Seed Orchard

Horning is located approximately 23 miles southeast of the city of Portland and 40 miles north-northeast of Salem, Oregon, near the small community of Colton and within Clackamas County. It lies within the Willamette River valley, between the Oregon Coast Range and the Cascade Mountains. Figure 1.2-1 shows the seed orchard location.

1.3 Scoping Comments and Issues

Numerous scoping-related activities were conducted for this EIS between 1999 and 2002. These are described in BLM's scoping report for Horning (BLM 2002a) and summarized in Section 5.1 of this document. Scoping comments received during this time are

Figure 1.2-1: Location of Horning Seed Orchard

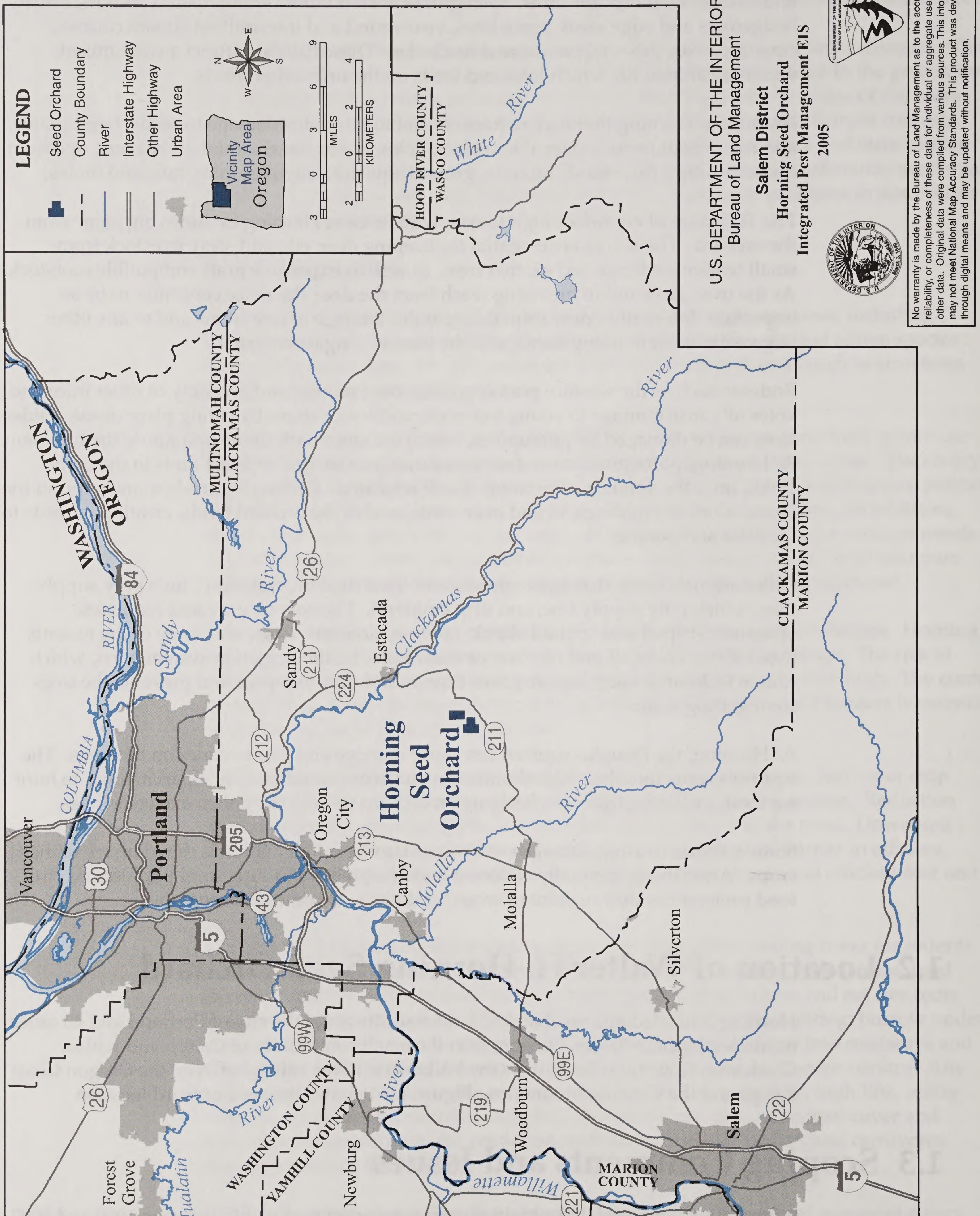


Table 1.3-1. Major Comment Categories

Comment Category	Number of Comments
Alternatives	2
Human health and safety impacts	4
Economic impacts	2
Ecological impacts	2
Soil impacts	1
Water quality impacts	1
General opposition to chemical pesticides	1
No comment/out of scope	7
Total Comments	**20**

described in detail in BLM's public comment summary report for Horning (BLM 2002b), and summarized herein. Twenty public comments were received from seven responders during the 1999-2002 timeframe. Many commentors had no comments or concerns about the proposed IPM program, or were interested only in finding out how to control their pests at home. These latter interests are considered to be out-of-scope comments and are not addressed in this EIS. Comments relevant to the scope of the EIS focused primarily on the alternatives and potential environmental impacts from using chemical pesticides. Table 1.3-1 summarizes the number of comments by major category. Note that some commentors had more than one comment. These comments reflect the major issues that require consideration by the decisionmaker in developing the ROD for this EIS.

Comments on alternatives generally were in favor of implementing less hazardous pest management practices, particularly no chemical pesticide use. One member of the public was interested in using bluebirds to control insect pests and also recommended that the orchard manage for cavity dwellers such as nuthatches, chickadees, and juncos. An adjacent landowner and a grazing cooperator both expressed concern about the potential human health impacts from pesticides: the landowner requested notification before any spraying so they could keep their child inside, to protect against exposure to spray drift; and the grazing cooperator was concerned about the potential health effects of consuming cattle that graze at the seed orchard. These commentors were also concerned about the potential economic impacts of pesticide use on their activities. Specifically, the adjacent landowner was concerned about the economic effects on his organic farm status and revenues, while the grazing cooperator thinks any pesticide use could result in undue hardship and limit the acreage available for grazing by her cattle and sheep. Finally, one commentor, who represented herself as well as the Coast Range Guardians and Canaries Who Sing, opposed chemical use and was in favor of non-chemical alternatives. She expressed concern about the effects of insecticides in particular (specifically esfenvalerate) on soil, tree health, and ecological resources, including plants, wildlife, and coho salmon. She provided copies of two recent court decisions relating to salmon and pesticide use, and to pesticides entering waters of the U.S.

All of the scoping comments received and considered to be within scope are addressed in this EIS. Specific environmental resources of concern identified during scoping and analyzed in Chapter 4 are human health and safety, soils, ecological resources (including vegetation, terrestrial wildlife, and aquatic species), water quality, and socioeconomics. This EIS also addresses potential impacts to other resources that were not identified during scoping, but required evaluation to determine if any impacts were possible: air quality, land use, noise, and cultural resources.

1.4 Relationship to Plans, Policies, and Programs

1.4.1 Related BLM Plans, Policies, and Programs

The Salem District Resource Management Plan (RMP) (BLM 1995) included the seed orchard within the Administratively Withdrawn land allocation. This allocation recognized existing management direction previously established for protection of specific resources, flora and fauna, and other values. These seed orchard values included preservation of genetic materials, production of improved seed, and various orchard developments and facilities.

The provisions of the Salem District RMP found in the resource program sections for Energy and Minerals; Land Tenure Adjustments; Rights-of-Way, Access, and Withdrawals; and the information in Appendices C—Best Management Practices-Roads, and E—Forest Genetics Program, apply to Horning. Except for these specific sections, the objectives and management actions/direction described in the Salem District RMP are not applicable to Horning.

Horning is administratively withdrawn. Section 204 of the *Federal Land Policy and Management Act* (FLPMA) of 1976 (43 U.S.C. 1700 et seq.) describes "withdrawal" as "withholding an area of Federal land from settlement, sale, location, or entry, under some or all of the general land laws, for the purpose of limiting activities under those laws in order to maintain other public values in the area or reserving the area for a particular public purpose or program." It was noted as a public land withdrawal in the Salem District RMP (BLM 1995). Specifically, Public Land Orders 3015 and 3609 withdrew a total of 480 acres at the seed orchard from surface entry and mining under general land laws and mining laws.

BLM's Oregon State Office concluded that this intensively developed, administratively withdrawn site was not intended to meet the standards and guidelines for forest health as generally provided in the Salem District RMP, which incorporated and superceded the Northwest Forest Plan (BLM 2000). In addition, standards and guidelines for various resources, such as Survey and Manage and Protection Buffer Species, while applicable to many administrative withdrawals, are not intended to be applied to intensively developed and used areas, such as Horning (BLM 2000). The orchard is not considered appropriate or available for conversion to a late-successional reserve or any other land use allocation which might directly serve as scarce or important habitat (BLM 2000). BLM's findings distinguish the unique nature of this site from other administrative withdrawals, such as Research Natural Areas, which are designed and designated to be important components of the broad ecosystem management direction under the RMP.

BLM prepared and supplemented an EIS for Port-Orford-cedar management in southwest Oregon (BLM 2004). No Port-Orford-cedar trees are present at the seed orchard. However, Horning will follow all recommendations contained in the ROD for the Port-Orford-cedar management EIS, should they become relevant in the future.

BLM prepared and supplemented a programmatic level EIS for Northwest Area Noxious Weed Control (BLM 1987). The ROD authorized use of specific herbicide formulations to control noxious weeds. The herbicide products contain dicamba, glyphosate, picloram, or 2,4-D as the active ingredient. Noxious weed control projects at Horning using these herbicides would be authorized under this 1987 ROD. Subsequently, BLM prepared an EIS and ROD for the Western Oregon Program for Management of Competing Vegetation (BLM 1992). This ROD selected an IPM approach with a preference for non-herbicide methods, and applies to all BLM-administered land in the Coos Bay, Eugene, Medford, Roseburg, and Salem Districts (Horning), and part of the Lakeview District. Actions covered under the 1987 Noxious Weed Control EIS are excepted from this decision.

BLM is undertaking a programmatic EIS for vegetation treatment on public lands administered by the BLM in the western U.S., including Alaska. This programmatic EIS will consolidate, update, and replace analyses contained in existing BLM vegetation treatment EISs, as well as include lands not analyzed in the existing documents. The programmatic EIS is not intended to affect specific Agency management decisions developed under local land-use plans, but will provide a baseline cumulative impact assessment that local BLM offices, including the Salem District Office, can use as they develop or update each district land use plan/EIS. The public scoping comment period on the programmatic EIS ended March 29, 2002. The programmatic Draft EIS was not published as of the date this seed orchard IPM Final EIS went into publication.

There is currently an injunction prohibiting BLM from applying herbicides. It has been partially lifted to allow applications for noxious weeds, as covered under the NEPA documents described in the preceding paragraph. Except for these uses, the injunction would have to be lifted (in its entirety or specifically for the seed orchard) before herbicides could be used as described in this EIS.

In the absence of this IPM EIS, project-specific EAs have been prepared for Horning for past esfenvalerate use to spray for cone and seed insects in production orchards, most recently in 1999, 2000, and 2001. The spring 2001 spray project at Horning was completed in February 2001, with a finding of no significant impact (FONSI) for the proposed action of aerially spraying esfenvalerate one time only in selected fields (BLM 2001). This EA was determined to also provide adequate NEPA analysis and documentation for a similar esfenvalerate spray project that was conducted in the spring of 2002. Once a decision is issued on the basis of this EIS, such project-specific NEPA documentation should no longer be required at Horning, since the ROD would make available to the seed orchard manager a variety of pest control methods that can be implemented to control specific pests in a manner that best fulfills orchard goals.

BLM's Eugene and Medford Districts in western Oregon are developing pest management EISs for their three seed orchards concurrently with this one for Horning. Specifically, the Eugene District is developing an EIS for the Tyrrell Seed Orchard, and the Medford District is developing an EIS for pest management at both the Provolt and Sprague Seed Orchards. Both EISs are being prepared under the same project schedule as this EIS for Horning.

1.4.2 Relevant Federal, State, and Local Statutes and Guidelines

Pest management at Horning would follow all relevant Federal, state, and local laws and regulations. Major legislation relating to this EIS includes the following:

- *National Environmental Policy Act of 1969* (42 U.S.C. 4321 et seq.), as amended: requires Federal agencies to prepare an EIS if a proposed action has a potential for significant environmental impacts.

- *The Federal Insecticide, Fungicide, and Rodenticide Act* (FIFRA) of 1947, as amended (7 U.S.C. 136 et seq.): establishes procedures for the registration, classification, and regulation of all pesticides. The Environmental Protection Agency (EPA) is responsible for implementing FIFRA; primary enforcement responsibilities for use-related violations are assigned to states with approved programs. Before any pesticide may be sold legally, it must be registered by EPA. EPA may classify a pesticide for unrestricted use if it determines that the pesticide is not likely to cause unreasonable adverse effects on applicators or the environment. States may classify pesticides for restricted use (which means they may be applied only by or under the direct supervision of a certified applicator or in accordance with other restrictions), even though EPA may not have done so.

- *The Clean Air Act, as amended* (42 U.S.C. 1857 et seq.): sets national primary and secondary ambient air quality standards, requires that specific emission increases be evaluated to prevent a significant deterioration in air quality, and provides EPA with authority to set national standards for performance of new stationary sources of air pollutants and standards for emissions of hazardous air pollutants.

- The *Clean Water Act* (33 U.S.C. 1251-1387) of 1984, as amended: charges EPA with protecting the nation's water resources and wetlands, and controlling the discharge of toxic chemicals. The Act defines water quality standards for priority toxic pollutants, oversees the industrial pre-treatment program, and provides local governments with the authority to control non-industrial discharges of toxics.

- The *Safe Drinking Water Act* (SDWA) of 1974 (42 U.S.C. 300(f) et seq.): established a national structure for drinking water protection activities. The Act authorized EPA to establish national, enforceable health standards for contaminants in drinking water; provided for public water system compliance through a Federal-state partnership; established public notification to alert customers to water system violations; and set up procedures to protect underground sources of drinking water.

  The 1996 amendments to SDWA required states to develop source water assessment programs (SWAPs) that outline an approach for conducting source water assessments, delineate the boundaries of areas from which public drinking water systems receive drinking water, and identify the origins of regulated and unregulated contaminants. In Oregon, the Oregon Department of Environmental Quality (ODEQ) has state primacy for implementing the SDWA and administers both the SWAP and the underground injection control (UIC) program through this authorization. Through both the SWAP and UIC programs, ODEQ seeks to ensure the protection of groundwater that is used for drinking water. BLM supports ODEQ's efforts by contributing data and information to ODEQ's UIC registry of sites. Among the sites registered under ODEQ's UIC program are Class V injection wells. EPA Region 10 defines Class V injection wells to be systems, structures, or activities that allow for subsurface placement of fluid directly. In most instances, a hole or a trench using piping would qualify if the purpose or intent is for subsurface discharge either through infiltration or injection. Operation and maintenance activities at Horning do not involve subsurface placement (that is, injection) of potential contaminants and therefore have not been registered with ODEQ. However, because the potential for an unintended spill or discharge always exists, best management practices for spill recovery that reference ODEQ's UIC best management practices (ODEQ 1999) would be developed and included in Horning's Spill Prevention, Containment, and Countermeasure Plan. In addition, design features included in the Orchard Water Management Plan (BLM 2002c) and the EIS preferred alternative are expected to minimize the impacts of an unintended spill to groundwater.

- The *Endangered Species Act* (ESA) of 1973 (as amended): establishes Federal policies and procedures for protecting endangered and threatened species of fish, wildlife, and plants. Section 7 requires Federal agencies to consult with the U.S. Fish and Wildlife Service (FWS) or the National Oceanic and Atmospheric Administration's Office of Fisheries (NOAA Fisheries) (formerly known as the National Marine Fisheries Service, or NMFS) to ensure that any action that they authorize, fund, or carry out is not likely to jeopardize the continued survival of a listed species or result in the adverse modification or destruction of its critical habitat (16 U.S.C. 1536 (a) (2)). In addition, the Act requires that if species proposed for listing are likely to be jeopardized, consultation must be held with the FWS or NOAA Fisheries. This consultation may result in modification or abandonment of an action.

  A biological assessment was prepared to document the Section 7 consultation process for the proposed IPM program. NOAA Fisheries issued a biological opinion concluding that the proposed action is not likely to jeopardize the continued existence of steelhead, chinook salmon, and coho salmon; the opinion specified reasonable and prudent measures, with associated terms and conditions, to further protect the species. See Section 2.3.3 for additional details and Appendix F.

- *Migratory Bird Treaty Act* (16 U.S.C. 703-711): except as allowed by implementing regulations, this act makes it unlawful to pursue, hunt, kill, capture, possess, buy, sell, purchase, or barter any migratory bird, including the feathers or other parts, nests, eggs, or migratory bird products.

- *Fish and Wildlife Coordination Act* of 1980 (16 U.S.C. 2901 et seq.): encourages Federal agencies to conserve and promote conservation of nongame fish and wildlife and their habitats to the maximum extent possible within each agency's statutory responsibilities.

- *Magnuson-Stevens Fisheries Conservation and Management Act*, as amended by the *Sustainable Fisheries Act* of 1996: requires the identification and protection of essential fish habitat (EFH) for important Federally managed fisheries resources (that is, marine and anadromous fisheries). In freshwater, EFH includes habitats for spawning and incubation, juvenile rearing, juvenile migration corridors, and adult migration corridors. Federal agencies are required to consult with NOAA Fisheries if their actions may adversely affect EFH. The ESA consultation process with NOAA Fisheries included evaluation of EFH impacts. In the biological opinion, NOAA Fisheries concluded that the proposed action may adversely affect EFH for chinook and coho salmon. NOAA further recommended that terms and conditions specified for ESA compliance be adopted as EFH conservation measures. The transmittal letter for the biological opinion and the biological opinion are provided as Appendix F to this Final EIS.

With respect to the ESA, the U.S. District Court in Seattle ruled on a case between the Washington Toxics Coalition and EPA on July 3, 2002 (*Washington Toxics Coalition et al. v. Environmental Protection Agency and Christine Todd Whitman, Administrator*). The purpose of this lawsuit was to compel EPA to consult with NOAA Fisheries (formerly NMFS) over its registrations of pesticides known to affect fish. The court found that EPA was in violation of ESA because EPA had not consulted with NOAA Fisheries, and determined that EPA needed to consult with them on 54 of the pesticides identified in the case, eight of which are proposed for use at Horning (acephate, chlorothalonil, chlorpyrifos, diazinon, dicamba, dimethoate, propargite, and triclopyr). Although the Court issued an interim injunction specifying no-spray buffers for ground and aerial applications of subject pesticides, specific agency actions such as the proposed action described in this Final EIS are excluded from the injunction by issuance of a no-jeopardy biological opinion from NMFS, as is the case for this proposed action.

In another lawsuit, the League of Wilderness and seven other environmental groups appealed a district court finding to the U.S. Court of Appeals for the Ninth Circuit, challenging the U.S. Forest Service's annual aerial insecticide spraying program covering over 628,000 acres of national forest lands in Washington and Oregon [*League of Wilderness Defenders et al. v. Harv Forsgren and U.S. Forest Service*, 309 F.3d 1181 9th Cir. (2002)]. The spraying was aimed at controlling a predicted outbreak of the Douglas-fir tussock moth, and included planned direct overspray of natural bodies of water during the course of treating forested areas. The plaintiffs asserted that the EIS was inadequate, and that the Forest Service failed to obtain a National Pollutant Discharge Elimination System (NPDES) permit, which is required by the *Clean Water Act* for point source pollutant discharges to water. Although the district court had granted summary judgment in favor of the Forest Service, the Ninth Circuit reversed the decision on appeal in an opinion issued on November 4, 2002. EPA issued an interpretive memorandum of the Ninth Circuit court's opinion on September 3, 2003 (EPA 2003). EPA stated that they believe the court misinterpreted EPA's regulations regarding NPDES permits, and that they will only follow the ruling within the Ninth Circuit court's area of jurisdiction (which includes Oregon). EPA is now proposing to codify the substance of the interpretive statement in regulation and finalize the rule. Within this region, EPA stated that they will require NPDES permits only for applications of pesticides directly over and into waters of the U.S. that do not comply with relevant FIFRA requirements. No such applications are part of BLM's proposed seed orchard IPM program.

A new threat to woodlands, forests, and nurseries was identified in 2000, with the discovery of the pathogen *Phytophthora ramorum* in California, which causes a disease

known as sudden oak death (SOD). It has a broad host range including hardwoods, landscape plants, herbaceous plants, and softwoods, and causes branch and twig dieback in conifers (USDA 2003). In Oregon, SOD was identified on forest lands in one county (Curry), where the host plants in the nine-square-mile infested area were destroyed. It was later identified in containerized plants at an Oregon nursery, prompting creation of an annual statewide inspection and certification program of plant growers and dealers. The U.S. Department of Agriculture recently issued an order specifying restrictions and certifications for interstate movement of nursery stock from quarantined areas (including the site of the previous infestation in Curry County) and regulated areas (including the rest of the state of Oregon), to prevent the spread of SOD to other parts of the U.S. beyond Oregon and California (USDA 2004). BLM monitors information bulletins from the Oregon Department of Agriculture and follows all relevant Federal, State, and local regulations and recommendations regarding SOD containment, prevention, and eradication.

BLM's pest management would be conducted in accordance with all applicable state and local government regulations, including two laws specific to the Department of the Interior and BLM: the *Sikes Act* (16 U.S.C. 670 et seq.), as amended, and FLPMA. The *Sikes Act* authorizes the Department of the Interior, in cooperation with state agencies responsible for the administration of fish and game laws, to plan, develop, maintain, and coordinate programs for the conservation and rehabilitation of wildlife, fish and game on public lands within its jurisdiction. FLPMA requires BLM to manage public lands and their resources for multiple use, and to develop resource management plans for lands under BLM's jurisdiction.

State and county weed control laws place responsibility for noxious weed control on individual land owners, including the Federal government. Permittees and grantees operating rights-of-way on BLM-administered land are required to comply with Department of the Interior herbicide use regulations. BLM must also coordinate with appropriate state agencies in managing state-listed plant and animal species when a state has formally made such designations.

1.5 Organization of this EIS

This document is organized into four main chapters. Background and support information, including a summary of the human health and ecological risk assessment, is provided in the appendices. The Final EIS presents five alternatives for managing pests at Horning, including the no action alternative, and examines the potential environmental impacts of each alternative. Chapter 1, Purpose and Need, identifies the purpose and need for action, provides an introduction to typical pests found at the orchard, and discusses the public issues surrounding pest management and other considerations. Chapter 2, Alternatives, presents and compares the alternatives, with information on how they would be implemented with measures to protect the environment. Chapter 3, Affected Environment, includes a description of the physical, biological, and social setting of the orchard. Chapter 4, Environmental Consequences, addresses changes likely to occur with implementation of any of the alternatives.

In addition to the four main chapters, the document contains these sections: Executive Summary; Table of Contents; Chapter 5—Consultation and Coordination (including scoping process, consultation list and a list of agencies, organizations, and individuals to whom copies of the statement were sent); Chapter 6—List of Preparers; Chapter 7—References; a list of acronyms; a glossary; and an index.

Additional detail and background information is presented in appendices:

A. Seed Orchard Pests
B. Monitoring Plan
C. Risk Assessment Summary
D. Risk Analysis of Sublethal Effects for Special Status Aquatic Species
E. Public Comments on Draft EIS and BLM Responses
F. NOAA Fisheries Biological Opinion Transmittal Letter and Biological Opinion

2.0 Description of Alternatives, Including Proposed Action

2.1 Background

2.1.1 Seed Orchard, Tree Improvement Program, and Genetics

BLM manages four centralized tree seed orchards in western Oregon: Horning in the Salem District, Tyrrell in the Eugene District, and Provolt and Sprague in the Medford District. Historically, the seed orchards' role was to provide genetically improved Douglas-fir and sugar pine seed and seedlings to the five western Oregon districts and the western Klamath Falls resource area for reforestation and progeny test programs. A major shift in management emphasis in the districts' RMPs sharply decreased the need for seeds for reforestation. Therefore, the seed needed for BLM purposes from the BLM seed orchards was greatly reduced. To allow BLM to cost-effectively manage the seed orchards, an effort has been made to share the seed orchards with other cooperators. Consequently, the seed needs from many of the orchard units have increased because of strong cooperator interest. The cooperators are the Oregon Department of Forestry; Confederated Tribes of Grande Rhonde; Boise Corporation; Cascade Timber Consulting, Inc.; IFA Nurseries; Roseboro Lumber Company; Simpson Resource Company; and Yule Tree Farms and Management Company. In addition, the Native Plant Materials Program is a partnership between BLM and nine area watershed councils; forty acres have been developed for this purpose.

Orchard Operations

There are two types of BLM seed orchards, each serving a different purpose. In *breeding and preservation orchard units*, trees from the same clone/family are planted in tight spacing and located together. The main purpose of these orchard units is to breed for advanced generation programs and/or preserve genetic material (clone banks). They do not represent the total genetic variation selected within the breeding zone. This variation is more appropriately preserved in the progeny test sites. In *seed production orchard units*, trees from different clones/families within the same seed zone are planted at wider spacing and are designed to facilitate good mixing of pollen and reduce self-pollination. The main purpose of the seed production orchard units is to produce genetically improved seed for reforestation. There are Phase I and Phase II seed production units. In most cases, the Phase I units have been established with the first generation clonal material, and will be the main source of seed for the current and next decade. Most of the Phase II units are undeveloped and are reserved for advanced generation orchards.

Currently, there are approximately 222 acres devoted to conifer seed production at Horning. The species include Douglas-fir, noble fir, western hemlock, western redcedar, sugar pine, and western white pine. The seed production orchards may produce 1,600 to 3,500 bushels of cones annually, depending on customer needs and crop stimulation success. In Douglas-fir and western hemlock, cone crops are stimulated using a combination of techniques including girdling, gibberellic acid (GA 4/7) injected into the trees, and calcium nitrate fertilizer at 200 pounds (lb) of nitrogen per acre applied at the drip-lines. A typical year would involve 200 trees treated with GA 4/7 and 800 trees treated with calcium nitrate. Between the success of stimulation efforts and natural cone crops, an average of 1,000 bushels of cones is harvested annually, based upon seed needs and customer requests.

Breeding and preservation orchards currently occupy approximately 69 acres. Another 106 acres have been cleared and established with ground cover. These are for development of second generation tree improvement and minor species orchards. Approximately 191.5 acres are occupied by structural facilities (including the building compound) or vegetated riparian stream buffers.

Figure 2.1-1 depicts the layout of Horning and its seed production and breeding and preservation units.

Cone and Seed Processing

Horning houses a seed plant/extractory which processes an average of 1,400 pounds of seed (approximately 2,500 bushels of cones) annually. Aside from processing the crop produced at Horning, it also processes cones and seed from other BLM orchards and field collections. As workloads have allowed during the last few years, Horning has processed cones and seed for several other state, county, and city agencies. The facility provides state-of-the-art cone storage, seed testing, packaging, shipping, and seed storage services.

Growing Containerized Seedlings in Greenhouses

The greenhouse complex consists of three greenhouses, a nursery work building, a native plant storage building with an attached shade house, several container storage areas, a loading dock, a pump house, and 500 square feet of cooler space. The greenhouses have 28,500 square feet (ft^2) of growing space which can accommodate 1,411,200 container seedlings at maximum production based on 100 seedlings/ft^2 (using three-cubic-inch growing containers). The shade house consists of 3,240 ft^2. It is used for natural stratification of native seeds and acclimatizing natives from the greenhouse before they are planted in the field.

The nursery's pure well water provides a neutral base for growing seedlings. Soluble fertilizers providing both macro and micro nutrients required for healthy plant growth are added through an overhead drop-riser irrigation system. This system is regulated automatically and provides specific delivery of fertilizers and pesticides by quadrants. Additionally, watering schedules and bench watering can be used for small specialty lots. The greenhouse is also equipped with a small mist bench area for vegetative propagation.

Native Species Grow-Out Beds

Forty acres have been developed and partially planted for grow-out of native grasses, forbs, and wetland species at Horning. Another 30 acres are planned for expanding the herbaceous native plant grow-out beds.

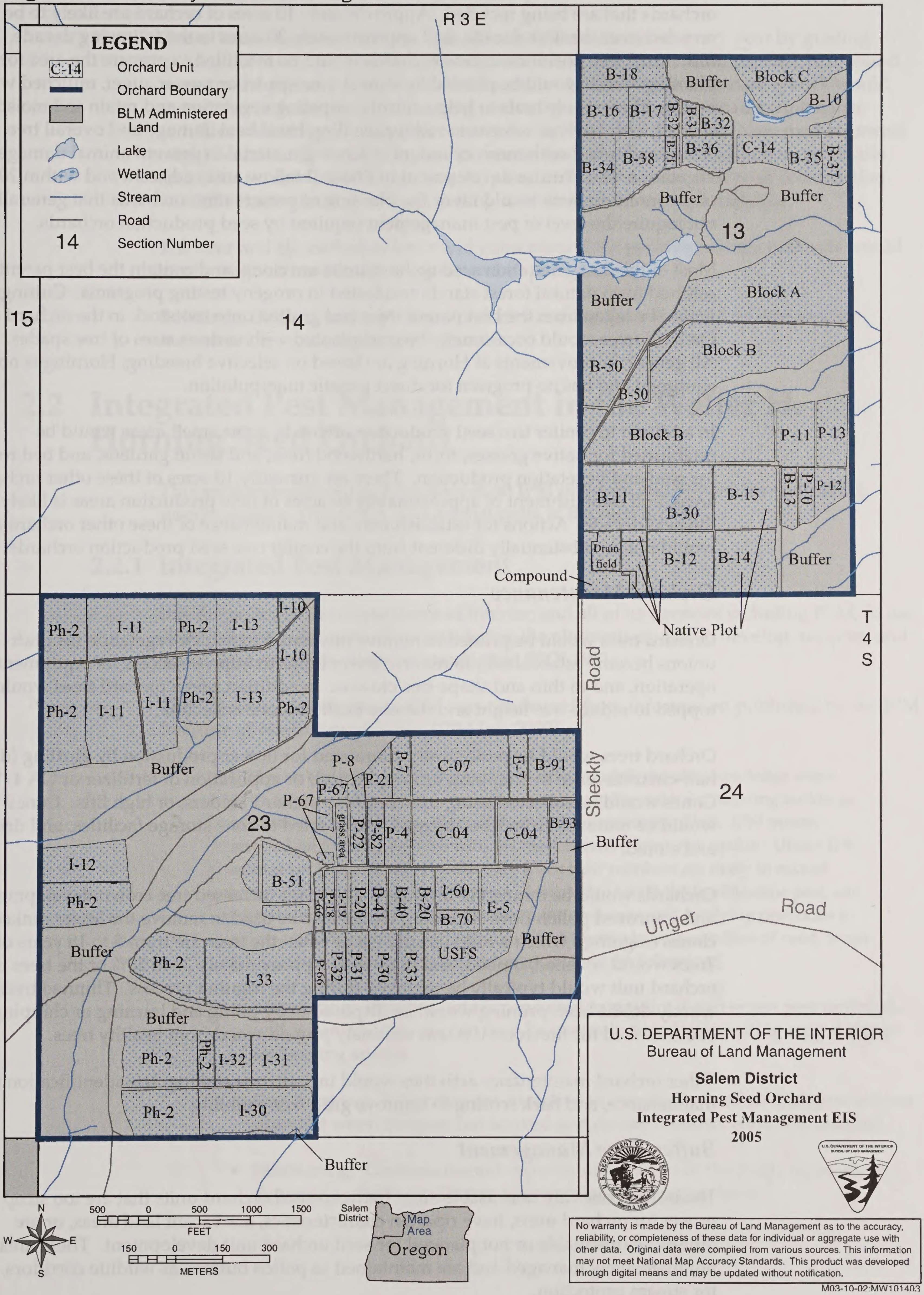
2.1.2 Ongoing Orchard Activities

Under all alternatives, routine management actions for orchard establishment and maintenance activities would continue to occur. However, these actions—which include orchard establishment, orchard maintenance, buffer zone management, and facilities/equipment maintenance—are not directly related to IPM and therefore are not evaluated in this EIS. See also discussion of District RMP in Section 1.4.1.

Orchard Establishment

Most land clearing at Horning has been completed. Any future site preparation would consist of preparing an area for a new orchard by removing existing stumps, subsoiling, rototilling or disking, leveling, and cover crop seeding. These site preparation activities would also occur as older orchards are recycled; that is, as trees become too large to harvest cones and are replaced with advanced generation orchard material.

Figure 2.1-1: Layout of Horning Seed Orchard



New orchards would periodically be established in the Phase II fallow areas and in orchards that are being recycled. Approximately 10 acres of orchard are likely to be recycled over the next decade, and approximately 30 acres in the following decade. Individual tree positions in new orchards would be rototilled to prepare the area for planting. Trees would be planted by shovel, tree spade, or power auger, mulched with porous fiber or poly mats to help control competing vegetation and retain soil moisture, shaded with cards or screens to reduce seedling basal heat damage and overall tree stress, and tubed with mesh cylinders or fencing material to prevent animal damage and vegetation loss. Future development of Phase II fallow areas adjacent and within 200 feet of perennial streams would favor the planting of preservation orchards that generally do not require the level of pest management required by seed production orchards.

Most of the first generation seed orchard units are clonal and contain the best parent trees selected from natural forest stands and tested in progeny testing programs. Cuttings would be taken from the best parent trees and grafted onto rootstock in the orchard units. Orchard trees would occasionally be transplanted with various sizes of tree spades. All genetic improvements at Horning are based on selective breeding; Horning is not equipped and has no program for direct genetic manipulation.

In addition to conifer tree seed production orchards, some small areas would be established for native grasses, forbs, hardwood trees, and shrub gardens, and bed rows for seed and vegetation production. There are currently 10 acres of these other orchard areas, and establishment of approximately 60 acres of new production areas is likely over the next decade. Actions for establishment and maintenance of these other orchard areas would not be substantially different from the conifer tree seed production orchards.

Orchard Maintenance

Orchard trees would be pruned to remove unwanted rootstock vegetation (as graft unions become established), to remove lower limbs to improve access for equipment operation, and to thin and shape tree crowns. In addition, some orchard trees would be topped to reduce tree height and thereby facilitate cone collection.

Orchard trees would be periodically stimulated for flower production by girdling (double half-circumference overlapping technique) and/or application of fertilizer or GA 4/7. Cones would be collected using tree climbing, orchard ladders, or high lifts. Cones would be removed from trees, bagged, transported to cone storage facilities, and dried and stored.

Orchards would be thinned to increase the light for increased tree crown development and improved pollen flow. Thinning would also be used to remove the lower ranked clones (roguing), which would usually occur when the trees are from 5 to 18 years old. Trees would be felled, limbed, and removed. Approximately 20 to 50% of the trees in an orchard unit would typically be removed during the roguing process. Thinned trees and woody debris from pruning would be disposed of by piling and burning or chipping; or could be sold for firewood if it was routinely pruned wood from healthy trees.

Other orchard maintenance activities would include tree staking, tree identification tag maintenance, and bark scoring to improve graft compatibility.

Buffer Zone Management

The buffer zones are non-usable areas between seed orchard units that are too steep or wet for orchard units, have riparian characteristics, are vacant land areas, or are otherwise unsuitable or not planned for seed orchard unit development. These areas are not intensively managed and are maintained as pollen buffers, as wildlife corridors, and for stream protection.

Facilities/Equipment Maintenance

Gravel access roads within the orchard would be maintained every year by grading, rocking (as necessary), and occasionally surfacing with chip seal to provide year-round access to the primary project areas of the orchard. The road maintenance work would sometimes include bar ditch cleaning and culvert maintenance. Road maintenance activities would occur on approximately 9.1 miles of road per year. New road segments might occasionally be built to provide access into newly established or new emphasis areas, but no new construction is anticipated at this time. Any new road construction would include grading, rocking, rolling, and ditch and culvert installation.

The deer and elk exclusion fence and gates around the perimeter of the orchards would receive regular maintenance, repair, and improvements.

Buildings, utilities, and a variety of vehicles and equipment would receive regular maintenance, repair, and improvements.

2.2 Integrated Pest Management in the Walter H. Horning Seed Orchard

This section describes the principles of an IPM program and options for controlling insects, disease, vegetation, and animal pests at the seed orchard.

2.2.1 Integrated Pest Management

It is the policy of the Department of Interior, and all of its agencies including BLM, to use chemical pesticides only after considering the alternatives; and to develop, support, and adopt IPM strategies wherever practicable (DOI 1981).

The following description of IPM was condensed from information published by the IPM Institute of North America, Inc. (IPM Inc. 2002).

> IPM is an approach to solving pest problems by applying our knowledge about pests to prevent them from damaging crops, harming animals, infesting buildings or otherwise interfering with our livelihood or enjoyment of life. IPM means responding to pest problems with the most effective, least-risk option. Under IPM, actions are taken to control pests only when their numbers are likely to exceed acceptable levels. Any action taken is designed to target the troublesome pest, and limit the impact on other organisms and the environment. Applying pesticides to crops, animals, buildings or landscapes on a routine basis, regardless of need, is not IPM. ...[Components of an IPM program include the following:]
>
> - Forecasting: Weather data is consulted to predict if and when pest outbreaks will occur. Treatments can then be properly timed, preventing crop damage and saving sprays.
> - Pest trapping: Traps that are attractive to insects are used so that growers can pinpoint when the pest has arrived and decide whether control is justified.
> - Monitoring: Growers inspect representative areas of the fields regularly to determine whether pests are approaching a damaging level.

- Thresholds: Before treating, growers wait until pest populations reach a scientifically determined level that could cause economic damage. Until that threshold is reached, the cost of yield and quality loss will be less than the cost for control.

- Cultural controls: The pest's environment is then disrupted by turning under crop residues, sterilizing greenhouse tools, and harvesting early.

- Biological controls: It is necessary for growers to conserve the many beneficial natural enemies already at work. They import and use additional biologicals where effective.

- Chemical controls: Growers select the most effective and appropriate pesticide and properly calibrate sprayers. They then verify that weather conditions will permit good coverage without undue drift.

- Recordkeeping: Records of pest traps, weather and treatment are kept for use in pest management decisions.

IPM for seed orchards is the maintenance of seed orchard pests at tolerable levels by the planned use of a variety of preventive, suppressive, or regulatory methods (including no action) that are consistent with orchard management goals. Each pest management activity is the end result of a decision-making process where pest problems and their impact on hosts are considered, and control methods are analyzed for their effectiveness, as well as their impacts on economics, human health, and the environment. Deciding which particular method would be used depends on several factors. Initial questions at the seed orchard might include, "Is it really necessary to control this pest? Can we live with the damage and still have the trees survive and produce suitable amounts of seed?" If the answers are yes and no, respectively, then decisions must be made as to what method(s) of control to use. Figure 2.2-1 graphically displays the steps involved in carrying out an IPM program in BLM seed orchards.

The focus of IPM is on long-term prevention or suppression of pests. The integrated approach to pest management incorporates the best-suited biological, chemical, and cultural controls that have minimum impact on the environment and on people. IPM is not pesticide-free management; however, a successful IPM program should result in the most efficient use of pesticides if and when they are needed.

Research into better and more effective control methods is also an essential part of this program. The seed orchard manager would regularly review the pest management methods available for use, including new and developing technologies, to ensure that the seed orchard utilizes the most effective methods of control while minimizing the potential for any adverse environmental or health impacts.

2.2.2 Pest Management Methods

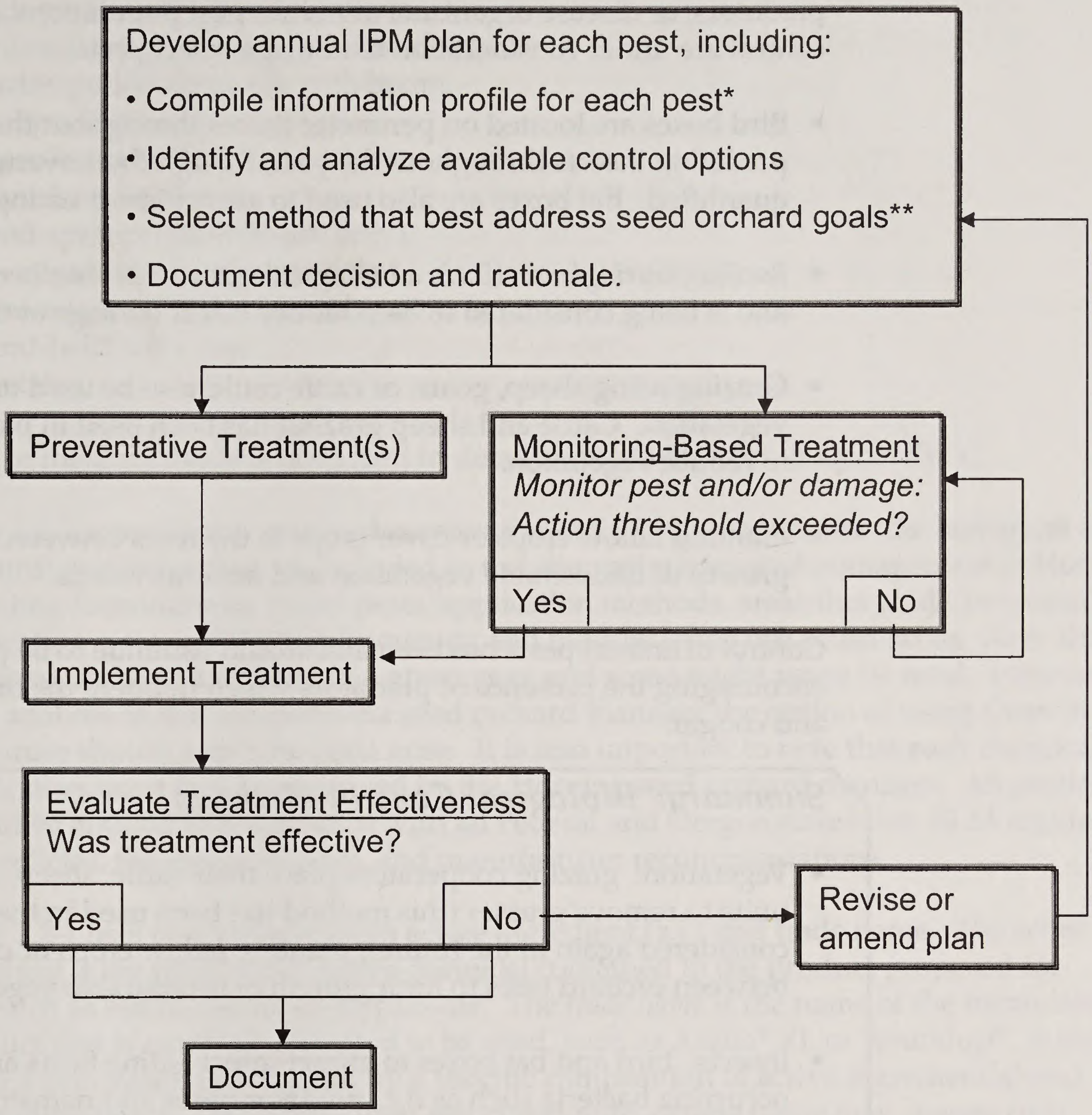
There are many methods available to manage vegetation, insects, disease, and animal pests at Horning. These methods generally fall into the following categories:

- Biological controls, such as bird or bat boxes to attract insect-eaters, or encouraging predators that can control animal pests.

- Chemical herbicides, insecticides, fungicides, and fumigants.

- Prescribed fire to remove vegetation.

Figure 2.2-1. Seed Orchard IPM Process



*Profiles will vary in depth and included information based on threat from any particular pest; may consist of a group of files, reports, and on-line data sources.

**Goals may vary between locations and ownerships, and over time. Possible goals might include high seed production, protection of human health, protection of the environment, and cost-efficiency.

- Cultural methods, including mechanical (tractor mowing) and manual (pruning) methods, mulch mats, and fences.
- Other methods, such as pheromone bait traps for insects and fertilization to promote overall tree health.

The subsections that follow outline each of these pest management methods in more detail.

2.2.2.1 Biological Control Methods

Biological pest control is the deliberate use of natural enemies such as parasites, predators, or disease organisms to reduce pest populations. Four types of biological control are under consideration to manage insect pests.

- Bird boxes are located on perimeter fences throughout the orchard. Birds are seen predating insects throughout the year, though their overall effect has not been quantified. Bat boxes are also used to attract insect-eating bats.
- *Bacillus thuringiensis* (*B.t.*), a biological insecticide, has been used in the greenhouses and is being considered to help reduce insect damage at the orchard.
- Grazing using sheep, goats, or cattle could also be used to help control undesirable vegetation. Cattle and sheep grazing has been used in past years in the orchard units to reduce vegetation.
- Planting fallow crops or cover crops in the rows between orchard trees also can limit growth of undesirable vegetation and noxious weeds.

Control of animal pests has been and would continue to be partially accomplished by encouraging the presence of predators which frequent the orchard, including coyote, fox, and cougar.

Summary: Biological Control Methods

- Vegetation: grazing cooperators place their cattle, sheep, or goats in the orchard units to remove grasses (this method has been used in the past and would be considered again in the future); planting fallow crops or certain cover crops in rows between orchard trees to limit growth of undesirable vegetation and noxious weeds.
- Insects: bird and bat boxes to attract insect-eating birds and bats, naturally occurring bacteria such as *B.t.*, predator mites and nematodes, lady bugs, and aphid lions.
- Animal pests: predators including coyote, fox, and cougar are present and encouraged to frequent the seed orchard grounds to aid in the control of animal pests.

2.2.2.2 Chemical Pesticide Methods

Four categories of chemical pesticides may be used at Horning:

- herbicides to control weeds,
- insecticides to control insects,
- fungicides to control diseases caused by fungi, and
- fumigants to control weeds, insects, and diseases.

Many private landowners and commercial operations (including those in the vicinity of Horning) rely extensively on chemical pesticides to control unwanted pests.

For many years, Horning has managed pests with very limited use of chemicals: esfenvalerate was used in a research project in 1990 and 1991, and was used to control cone and seed insects in one application per year from 1999 through 2002.

Pesticides may be applied using various types of equipment. These include:
- aerial, using helicopter (esfenvalerate application only),
- airblast sprayer,
- high-pressure hydraulic sprayer,
- hydraulic sprayer with hand-held wand,
- tractor-pulled spray rig with boom,
- backpack sprayer,
- capsule implantation,
- granular spreader,
- hand sprayer (greenhouse only),
- chemigation (greenhouse only),
- total-release canister (greenhouse only).
- hand-held wick, and
- injection.

Each of these methods is described in detail in an attachment to Appendix C.

Table 2.2-1, provided as an attachment at the end of this chapter, lists the biological and chemical pesticides that are included in the alternatives for pest management at Horning, including formulations, target pests, application methods, areas that could be treated, application rates, application frequency, and months when use could occur. Note that not all chemicals would be used in a given year, and some might never be used. However, their analysis in this EIS gives the seed orchard manager the option of using them in the future should a specific need arise. It is also important to note that each chemical application must first be approved by the Horning seed orchard manager. All pesticides would be applied in compliance with all Federal and Oregon state laws, BLM regulations and policies, the pesticide label, and manufacturer recommendations.

Table 2.2-1 lists pesticides by both active ingredient (a.i.) and trade name. The *active ingredient* is the pesticidally active chemical contained in the product proposed for use, such as esfenvalerate or glyphosate. The *trade name* is the name of the formulated product that is currently expected to be used, such as Asana® XL or Roundup®. A trade name's *formulation* is described by a specific composition of active ingredient(s) and other ingredients. The formulation associated with a trade name may change over time. The chemical pesticide methods proposed in this EIS are described fully as the active ingredients listed in Table 2.2-1. The trade names provided in the table and the associated % a.i. are examples, and are current at the time of EIS publication. The trade names illustrate the formulations that may be used, but are not intended to limit the proposed IPM program to exclusive use of those formulations that are named in the table. Other formulations of the listed active ingredients may be substituted, at the same rate of application described in the table. The table presents application rates in terms of a.i. per acre or per tree, and will therefore remain applicable to any trade name or formulation of the listed active ingredients.

Summary: Chemical Pesticide Methods

- Vegetation: herbicides, including dicamba, glyphosate, hexazinone, picloram, and triclopyr.

- Insects: insecticides, including acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, horticultural oil, imidacloprid, permethrin, propargite, and Safer® soap.

- Disease: fungicides, including chlorothalonil, hydrogen dioxide (in greenhouse only), mancozeb (in greenhouse only), propiconazole, thiophanate-methyl (in greenhouse only), and dazomet (a soil fumigant).

2.2.2.3 Prescribed Fire

Prescribed fire may be used for removing vegetation in native species beds prior to planting or in limited areas in some orchard units. High temperatures, created through the use of a propane-fueled flame wand, kill any existing herbaceous material, providing a weed-free bed for growing native plants, and quickly remove dead plant litter. Pile burning may be used to dispose of cut or cleared vegetation or spent sugar pine cones. Grass straw may also be burned between the rows in the native plant garden to control disease.

Summary: Prescribed Fire

- Vegetation: propane-fueled flame wands for vegetation removal in native plant beds prior to planting, small patches of underburning in orchard units, pile burning of cut/cleared vegetation, pile burning of spent sugar pine cones.

- Disease: burning grass straw in bed rows in the native plant gardens.

2.2.2.4 Cultural Methods, Including Manual and Mechanical Methods

Cultural control refers to the use of methods that make the habitat less suitable for pests or prevents, suppresses, or removes them. Cultural methods include both manual and mechanical control methods.

Cultural control methods for vegetation include hand-pulling or using non-powered and powered hand tools and machinery to cut and clear vegetation.

- Mulch mats made of polypropylene and nylon mesh can protect seedlings from competing vegetation. They are placed over bare mineral soil following planting. The matting is typically three or four feet square and is held in place with metal or plastic pins placed in the corners. The tree protrudes through a slit in the middle of the sheet. Maintenance is minimal and the mats can be left on indefinitely.

- Hand weeding removes undesired vegetation from the native grass beds two to three times during the growing season. Hand weeding also takes place several times a year around the office compound.

- Tractors are used for mowing, with various blade attachments. Seed production orchards (28 ft x 28 ft spacing) are mowed diagonally. Breeding and preservation orchards (14 ft x 14 ft spacing) are mowed and cross-mowed using flail mowers. This leaves a 6-ft unmowed area around the base of each tree. Orchards are typically mowed three times during the summer, during the end of March/April, during May/June, and then again in July/August. Mower heights are set at about 2½ inches to avoid scalping the ground surface, which would open up growing space for other unwanted vegetation. Close mowing, using a 4-ft flail mower or a walk-behind rotary mower, is often done around trees in young orchards to cut vegetation that remains following treatment with the large mowers. A 5-ft swath is mowed several times during the growing season along roadsides for controlling low vegetation. Taller, overhanging vegetation is mowed every year using an articulating mower with an 18-ft reach. Fence lines, where accessible, are mowed with 5- or 6-ft rotary mowers to provide clear access around the orchard perimeter and to create a fire break.

- Brush in the orchards is generally controlled by mowing. However, hand cutting (using hand shears, loppers, and chain saws) of brush is often done around the base of the tree.

- Gasoline-powered string trimmers are utilized for cutting tall grass around the office compound.

- Tilling is used to physically remove the weedy vegetation at some locations. A 4- or 5-ft tiller is used around the native plant beds to maintain an unvegetated buffer. Tilling is usually done in spring and fall.

Pruning is done in western white pine and sugar pine stands to remove lightly infected branches having blister rust; severely infected trees are removed. During orchard development, stumps and roots were removed to a depth of three feet, to eliminate much of the potential for root diseases. Although these diseases are present in adjacent stands, the likelihood for them to cause significant damage prior to recycling the orchards (at which time the stumps would be removed and ripping would occur again) would be minimal. At present, stumps are cut flush to the ground surface. In the greenhouse, knocking or blowing water off seedlings and control of air flow through the use of fans and convection tubes helps to control disease.

Orchards are rogued and thinned to allow desirable clones to thrive and produce bountiful crops. Thinning opens up the crowns, allowing additional light to reach the crown surface. Thinning also increases available soil moisture to residual trees.

For animal pests, particularly gophers, live trapping and relocation or kill trapping are possible alternatives. Deer and elk exclusion fencing reduces browsing damage. An eight-foot steel mesh fence surrounds the orchard. Vexar™ tubes, approximately one-foot tall, are placed around newly planted seedlings. These tubes provide a barrier to voles, moles, and rabbits, which can damage the cambium layer of seedlings. Sticky traps in the greenhouse and screening to exclude squirrels from seed extractory and cone shed are other barrier methods used to control animal pests.

In the greenhouses, cultural controls include overhead convection tubes that provide heat and good air circulation to promote drying and disease control. Greenhouse 1 uses incandescent and fluorescent lighting to extend the photoperiod and meet special growing conditions for some species. Polyvinyl chloride pipes are used to knock water off plants after watering, and blowers are used to facilitate drying. Bird netting excludes birds and mice.

Summary: Cultural Control Methods

- Vegetation: hand-pulling, non-powered and powered hand tools to cut and clear, tractors with various blade attachments for mowing, gasoline-powered string trimmers, tilling an unvegetated buffer around native plant beds, mulch mats.

- Disease: pruning, thinning, stump grinding; in greenhouse, knocking or blowing water off seedlings and control of air flow through the use of fans and convection tubes.

- Animal pests: trapping of gophers, porcupines, and other small mammals, fencing that excludes deer and elk from orchard, Vexar™ tubes to protect seedlings, use of sticky traps in greenhouse, screening to exclude squirrels from seed extractory and cone shed.

2.2.2.5 Other Control Methods

Simon Fraser University, British Columbia, previously tested pheromones that attract the Douglas-fir gall midge at Horning. Results were mediocre to promising, depending on formulation. Research may continue in the future on this method.

To promote overall tree health, cone production, and disease resistance in the orchards, fertilization and cone stimulation are used. Calcium nitrate is used in specific orchards in March to help stimulate flower production for the following year's cone crop. It is applied with a fertilizer spreader mounted on a cushman around the drip-line of trees at a rate of about 200 lb of nitrogen/acre. Every three to four years, a general fertilization is completed to improve the nutrient levels of the trees and grass cover crop. Although mowing is more intense for the first year, the nutrient boost appears to keep the desirable ground cover thriving and invasive species at bay. Fertilizer mixes and rates are determined based on foliar and soil analyses. Application details for fertilizers are included in Table 2.2-1.

Summary: Other Methods

- Pheromone bait traps for insects.
- Fertilization to promote overall tree health, cone production, and disease resistance.

2.3 Alternatives

2.3.1 General Description and Features Common to All Alternatives

Five alternatives based on the pest management approaches described in Section 2.2.2 were identified and evaluated by BLM to address the need for a pest management program at Horning, as follows:

- Alternative A—Maximum Production IPM
- Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)
- Alternative C—Ground-Based IPM
- Alternative D—Non-Pesticide Pest Management
- Alternative E—No Action: Continue Current Management Approach

There are several features common to all alternatives. Pest management methods that are common to all alternatives are non-pesticide biological methods, cultural methods, prescribed burning, and other control methods. Additional activities common to all alternatives include orchard management activities unrelated to pest management (see Section 2.1.2) and protection measures that would be associated with a given pest control method under any alternative in which it is included. These protection measures are described in the following paragraphs.

Protection measures are intended to ensure the proper and safe application of pesticides at Horning. FIFRA requires pesticide manufacturers to register their chemicals with EPA, and list the allowable uses, application rates, and special restrictions on each pesticide's label. The pesticides considered for use at Horning are all registered under FIFRA. Application operations would comply with the label rates, uses, and handling instructions, in accordance with Federal law. In addition, the following procedures would be designed and implemented by Horning, and routinely observed in pesticide applications. If output from the monitoring plan (see Appendix B) indicates that more protection is needed, these protection measures may be altered over the life of this IPM program to provide more (but not less) protection to workers, the public, the environment, and ecological resources:

Worker Protection Measures

- Pesticide treatments would frequently be completed under contract by licensed pesticide applicators. BLM would administer the contracts for compliance.

- A Job Hazard Analysis for pesticide applications would be developed, providing a detailed description of the jobs and associated risks involved with pesticide use and application, and identifying requirements for personal safety equipment, training, and certification to perform specific tasks.

- The seed orchard would utilize its Pesticide Safety Plan.

- Pesticide applications would be conducted in compliance with all aspects of EPA's Worker Protection Standard under FIFRA, including protection during applications, restricted entry intervals, personal protective equipment, notification of workers, decontamination supplies, emergency assistance, pesticide safety training and safety posters, and access to labeling and site-specific information.

- All workers involved in pesticide applications would be required to participate in a pesticide exposure monitoring program. Testing for cholinesterase inhibition would be conducted on BLM employees applying organophosphates. Also, workers with declared hypersensitivity or who display symptoms of hypersensitivity to pesticides would not be assigned to application projects.

- Material safety data sheets would be posted at storage facilities and made available to workers.

- Appropriate protective clothing would be worn by all workers, as required by each pesticide's label.

- All applicators would be trained and licensed; this training would be confirmed by the seed orchard manager.

- For all application methods except spot treatments using hand-held application equipment, treated areas would not be re-entered until sprays have dried or until the stated label re-entry period has been met, unless protective clothing is worn and early re-entry is permitted by the label.

Public, Environmental, and Ecological Protection Measures

<u>General</u>

- Prior to applying pesticides with potential for drift to surface water, Horning would notify downstream water users within one-half mile of the project area, and adjacent landowners who could be directly affected by accidental drift or water transport from the pesticide application area.

- Warning signs would be posted to discourage entry into treated areas.

- Pesticides would be applied within the parameters of prescribed environmental conditions stated on the label.

- Temperatures would be monitored carefully.

- No spraying would occur if snow or ice covers the target foliage.

- If possible, spraying would be conducted during the early morning or late evening, allowing foliage to dry before pollinators become active.

- Orchard fields would be mowed or grazed prior to insecticide applications, to remove floral components on ground cover that would attract pollinators, such as bees (only if pollinators are active).

- Chemical weed control within 20 feet of perennial or non-perennial streams with flowing water at the time of application would be limited to spot hand applications.

- Application for invasive weeds within the area of the stream bank would be made by properly licensed applicators using only the Rodeo® formulation of glyphosate. These treatments would include precautions such as application during lowest flow, spray shields to protect any open water, and transportation of only the required small amounts of the product to the application site to limit the potential for spill impacts. In stream reaches where foliar applications of Rodeo® are used to treat knotweed growing in dry portions of the stream channel below the ordinary high water elevation, application is limited to the dry portions of the stream channel in the preferred in-water work period, in accordance with Oregon Department of Fish and Wildlife (ODFW) guidance.

- To avoid the potential for rapid transport to the aquatic system, only application for control of invasive weeds (as described in the previous paragraph) would occur within the grassed waterway zones containing tile. These tile zones would be marked on the ground. The width of the buffer along these tiled waterways could vary based on the topographic condition of the tiled area; however, a minimum of 25 feet on each side of the tile zone would be used. The tile zones would not be mowed, to allow the development of a grass and shrub canopy that can assist in capturing any drift from adjacent application areas.

- Aerial application in adjacent seed production orchards would be designed to minimize drift into the tile zones by means such as not applying aerially in portions of the orchard units. In native plant areas, the tile zones would be used to produce riparian species without the application of chemical pesticides; these species could assist in preventing any mobile chemicals contained in overland runoff from entering the stream system. If water quality monitoring indicates the presence of any applied chemical pesticides in the tile zones, temporary control of drainage in the specific tile would be implemented and pesticide application in the drain tile area would be discontinued until appropriate controls are designed to avoid introduction into tile.

- The monitoring program, detailed in Appendix B to this EIS, would be implemented as described for chemical pesticide applications.

- No carrier other than water would be used to mix (dilute) the pesticide products for application. In some cases, surfactants or adjuvants may be added to application mixtures of pesticides to improve their effectiveness or minimize handling and application problems. The seed orchard will only use surfactants or adjuvants that do not contain any ingredients on EPA's List 1 or 2, where listing indicates a chemical is of toxicological concern, or is potentially toxic with a high priority for testing (EPA 2000a). If a surfactant or adjuvant that contains any List 1 or 2 ingredients is considered, the risk associated with that chemical would be evaluated before a use determination is made.

- Maintenance and calibration of spray equipment will occur at least annually to ensure proper application rates.

- No more than one application of picloram will be made on an area in any given year to reduce the potential for picloram accumulation in the soil.

- Permethrin and esfenvalerate will not be used in the same year.

Runoff

- Pesticides shall not be applied under the following weather and soil conditions unless the product label specifically recommends otherwise. (1) Within 72 hours of predicted precipitation that would result in runoff and measurable increases in streamflow. To predict this, use a combination of precipitation forecasting, antecedent soil moisture conditions and current streamflows. (2) In areas with standing water and saturated soils. (3) In unstable air situations that may affect spray pattern or lead to offsite movement of spray, such as high air temperatures, during temperature inversions.

- Soil aeration equipment would be used in orchard blocks prior to aerial or airblast application to promote rainfall infiltration into the soil surface and decrease risk of runoff, as weather conditions permit.

- At a minimum, stream course and wetland buffers would be established within guidelines prescribed by the pesticide label.

- Fertilizer will not be applied within 50 feet of any stream, wetland or other waterbody.

- Fertilizer loading areas shall be at least 100 feet from perennial streams.

- If rain has preceded an intended application window, units would be checked for their infiltration capacity, avoiding fertilizer application when standing water is visible on the soil

- Fertilizer applications would be timed, to the extent predictable by weather forecasts, to not coincide or closely precede a storm event that could result in substantial runoff.

- No chemical pesticides would be applied to road or ditch surfaces that directly contribute to stream channel flow, nor to fencelines within 50 feet on either side of stream channels.

- Silt catchment barriers, such as bio-bags, will be installed across all ephemeral drainages located adjacent to or inside treatment units during periods when overland flow may occur following pesticide application. The function of these barriers will be to catch organics and sediment leaving the treatment area.

Spill

- Equipment used for pesticide transport, mixing, and application would be properly maintained to avoid leaking pesticides into water or soil.

- Pesticides would be mixed and equipment cleaned in areas protected (e.g., paved and bermed, or on a portable bermed mixing pad) from the potential for runoff to surface waters or leaching to groundwater in the case of a spill. Chemical containers would be kept in plastic drip pans that are large enough to hold the entire volume of each container in case the containers develop leaks.

- To prevent the impacts to aquatic species associated with a spill, chemical pesticides would not be transported by air or ground over the perennial tributaries to Nate Creek in Section 23.

- To prevent the impacts to aquatic species associated with a spill, tank-mixed pesticides would not be transported along the gravel road east of orchard unit B14 within 50 feet of the stream channel.

- All chemical loading operations would occur within the orchard building compound except for applications planned for the area north of the Swagger Creek tributary in Section 13. Applications to be made in this area would be prepared in a mixing area 500 feet from stream channels in that subsection. The pesticide to be used would be brought over to this area in a spill containment enclosure and only the amount needed for the tank mix would be transported. Tank-mixed insecticides or fungicides would not be transported by ground over the perennial tributary to Swagger Creek in Section 13.

- A spill containment kit would be on-site in the orchard building compound.

- Procedures outlined in an orchard Spill Prevention, Containment, and Countermeasure Plan would be followed if there is any spill of oil or hazardous materials, including pesticides.

- Design prescribed burns to minimize disturbance of riparian ground cover and vegetation, and any other habitat characteristic that could be damaging to long-term ecosystem function. If riparian areas are inadvertently damaged during a prescribed burn, immediately prepare and implement a rehabilitation plan designed to restore riparian ground cover and vegetation. Ensure that all vehicles, including emergency equipment, are not operated, maintained, or stored next to any stream, water body or wetland. Ensure that all vehicles, including emergency equipment, are not fueled within 150 feet on any waterbody. Appropriate fire suppression equipment shall always be at the project site during a prescribed burn.

<u>Drift</u>

- All applications of liquid pesticides would occur early in the morning when wind is minimal (<6 mph). Wind speed will be monitored on-site prior to and during spray applications. Operations will be suspended if wind speeds exceed 6 mph. Application will not occur when wind direction is toward flowing streams.

- Factors such as relative humidity, wind speed, and air temperature would be considered to determine the timing of applications that would minimize the potential for off-target drift.

- Pesticide applications would not be made during temperature inversions.

- Drift cards would be placed on all sides of areas to be treated when liquid pesticides are used, and applications would cease if there is any indication that chemical is moving out of the target area.

- When spraying trees within two tree rows from the edge of treatment unit perimeters, spraying will be done by directing the nozzle towards the center of the treatment unit, minimizing the chance for drift outside the designated treatment areas.

<u>Aerial</u>

- Before reconnaissance and operational flights, BLM would discuss objectives and concerns with the pilot performing the operation. The project boundaries would be reviewed using aerial photos and appropriate maps on the ground by the pilot and BLM project leader immediately prior to beginning application.

- BLM would clearly mark the application units and buffer boundaries with visible cones and flagging in such a manner that would allow visual identification from the

air. BLM would deploy smoke flares in each unit prior to application to provide for pilot recognition of wind speed and direction.

- BLM would place drift cards along all sensitive buffers and along stream channels where drift or drip entry is possible. These would generally be placed along stream buffers and under the designated flight path when crossing the main tributary to Swagger Creek (Stream 6).

- Flight paths during operation would not be located over surface water bodies except for a designated corridor across the main tributary to Swagger Creek (Stream 6).

- BLM would flag a designated corridor for a helicopter flight path across Stream 6. The helicopter would travel from the load area to application areas in units north of the main tributary to Swagger Creek (Stream 6) using this corridor, making the least number of crossings possible. This is intended to reduce the potential for drip to enter Stream 6.

- Any reconnaissance flights over water bodies would be made with empty tanks.

- Areas immediately adjacent to no-spray buffers would be treated prior to spraying the remainder of the unit. Initial application flight paths would be flown parallel to the buffer with the boom closest to the sensitive area turned off during the nearest pass. This would reduce the likelihood of accidental overspray into buffer areas with stream channels.

- To minimize the potential for overspray and drift, the pilot would avoid any banked turns against the protection buffers.

- The minimum practical boom length should be used, and must not exceed 75% of the rotor diameter.

- Aerial applications would be designed to deliver a median droplet diameter of 200 to 800 microns to reduce drift.

- Spray would be released at the lowest height consistent with pest control and flight safety. This would optimize the amount of spray reaching the target trees and reduce the amount reaching the ground.

- Spray "clean out" areas would be designated in orchard units B50 and B11 (greenhouse effluent irrigation area) or in areas which have no flowing streams within 500 feet.

2.3.2 Alternative A—Maximum Production IPM

Under this alternative, the primary goal is the maximum production of seeds and plants with a very low level of acceptable losses. Horning's seed orchard manager would have all the methods of pest management listed in Section 2.2.2 available for use, including all identified biological, chemical, prescribed fire, cultural, and other pest control methods. An effective IPM strategy for all orchard pests would be used under this alternative, including monitoring pest levels and treating if action thresholds are exceeded. However, the primary management objective, which would be reflected in the annual IPM plan (see Figure 2.2-1), would be to maximize seed production for annual BLM and cooperator seed needs by aggressively controlling cone and seed insects and other limiting factors. The most effective insect control measures would be implemented, to maximize seed yield and reduce damage to the seed crops with low acceptable seed losses, emphasizing production above other less-effective control methods and considerations, with a low threshold for initiating treatment.

2.3.3 Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Alternative B is BLM's preferred alternative. An effective IPM strategy for all orchard pests would be used under this alternative, including monitoring pest levels and treating if action thresholds are exceeded.

Under this alternative, the seed orchard manager would have access to the full list of pest management methods identified in Alternative A, with the exceptions listed below. These limitations were identified by reviewing the results of the quantitative risk assessment (summarized in Appendix C), considering the scoping comments, in response to the findings of monitoring conducted following the 2001 and 2002 spray projects, and responding to recommendations made by district interdisciplinary team members.

These limitations, listed below, address each risk identified during the risk assessment for Alternative A (summarized in Table 4.6-2 for human health and Table 4.7-2 for wildlife and aquatic species). Each quantitative limitation was calculated by varying the application scenario parameters in the model spreadsheet until the risk was lowered to the acceptable level. Parameters that were varied were those that the seed orchard manager can limit when approving the application, such as application rate, frequency, length of time to re-entry, total area or number of trees treated, and distance from area assumed to receive drift in the risk assessment scenario. The resulting risks correspond in each case to the negligible risk levels for human health, terrestrial wildlife, and aquatic species (see Section 4.6.1 for human health risk methodology and Section 4.7.1 for non-target species risk methodology).

To protect worker health:

- Diazinon would be applied to no more than 250 trees in one day at a maximum rate of 0.015 lb a.i. per tree (nor any combination of number of trees treated and application rate with a total amount of diazinon applied more than 3.75 lb a.i.) by any individual worker who is conducting both the mixing/loading and application activities.

- Dimethoate would be applied to no more than 22 trees in one day at a maximum rate of 0.13 lb a.i. per tree (nor any combination of number of trees treated and application rate with a total amount of dimethoate applied more than 2.86 lb a.i.) by an individual using the high-pressure hydraulic sprayer, and an individual other than the applicator would conduct the mixing/loading activities. If more than one applicator sprays trees during a single day, different mixer/loaders would prepare each pesticide mixture.

- An individual conducting hand pollination activities would not work on trees that had been treated with diazinon until at least 11 days post-application.

- An individual applying dicamba using a backpack sprayer would apply no more than 0.61 lb a.i. during any given day.

- An individual applying hexazinone using a backpack sprayer would apply no more than 6.5 lb a.i. during any given day.

- The frequency of mancozeb use in the greenhouses will typically be only twice per year, with a maximum frequency of 10 times per year. Weighing and monitoring personnel will allow 24 hours to elapse before handling seedlings treated with mancozeb.

To protect ecological resources:

- Chlorpyrifos would not be applied within 25 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application

methods).[1] It would not be applied to more than three acres in any twelve-acre area within a 14-day period, at a rate no greater than 1 lb a.i. per acre .[2]

- Diazinon would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods).[3] It would not be applied to more than 150 trees at a rate of 0.015 lb a.i. per tree (nor any combination of number of trees and application rate more than 2.25 lb a.i. applied) in any 12-acre area within an 11-day period.[4]

- Dimethoate would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods).[5] It would not be applied to more than five trees at a rate of 0.13 lb a.i. per tree (nor any combination of number of trees and application rate more than 0.65 lb a.i. applied) in any three-acre area within a seven-day period.[6]

- In areas north of the main tributary to Swagger Creek, non-chemical vegetation control would be emphasized to protect the organic herb farm, private livestock breeders, and the road crossing the dam at Horning Reservoir; however, limited quantities (to reduce any spill impacts) of propiconazole, the Rodeo® formulation of glyphosate, and triclopyr triethylamine salt may be tank-transported for use in a few select areas.

- No pesticide would be applied through aerial, airblast, or high-pressure hydraulic sprayer methods within 200 feet of perennial or intermittent streams to limit the potential for drift. From the edge of the 200-foot buffer to 50 feet from the stream bank, pesticide application would be limited to methods that preclude drift. These methods could include backpack sprayers with wicks or wands, implants, and foams or other no-drift technologies (Table 2.3-1). These buffers may be adjusted as drift monitoring results are obtained that demonstrate that either an increased or a reduced buffer width is appropriate to prevent chemical introduction into the waterways (buffer widths will not be decreased during the term of the present NOAA-Fisheries biological opinion, which expires on December 21, 2009).

- From the stream bank to the 50-foot buffer area, only cultural methods, injections, stump painting, and hand-held wands with wicks would generally be used to control highly invasive weeds (Table 2.3-1). However, herbicide application with a backpack sprayer may also be used to treat noxious weeds if the plant populations become large enough and treatment by hand-held wick and injection has not proven to be effective in controlling the plants at that location. Chemical treatments would only be used on highly invasive non-native species—such as knotweeds (Japanese, Himalayan, and giant), and purple loosestrife—that would not be effectively controlled with other methods. As stated above, this buffer zone may be adjusted if drift monitoring results are obtained that demonstrate that either a reduced buffer would not introduce chemicals into the waterways or that a wider buffer is required (buffer widths will not be decreased during the term of the present NOAA-Fisheries biological opinion, which expires on December 21, 2009).

- Fertilizer application rates would be limited to those identified in the typical scenarios in the risk assessment (summarized in Appendix C).

- If calcium nitrate is applied to trees that are within 500 feet of streams after April 30, the fertilizer in these areas would be "watered in" if there is no rainfall within a week.[7]

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[1] To protect the song sparrow, western meadowlark, streaked horned lark, and western pond turtle.
[2] To protect all terrestrial species.
[3] To protect the song sparrow, Pacific tree frog, western meadowlark, streaked horned lark, and western pond turtle.
[4] To protect all terrestrial species.
[5] To protect the song sparrow, western meadowlark, streaked horned lark, and western pond turtle.
[6] To protect all terrestrial species.
[7] To protect western pond turtles which, if present, would be nesting from approximately May 15 to July 31.

Table 2.3-1. Minimum Pesticide No-Spray Buffers [1, 2]

Chemical	Application Method	Minimum Stream Buffer (ft)
Esfenvalerate	Aerial	200
Chlorpyrifos Esfenvalerate Permethrin	Airblast sprayer	200
Acephate *B.t.* Diazinon Dimethoate Esfenvalerate Horticultural oil Permethrin Propargite Chlorothalonil	High-pressure hydraulic sprayer	200
Propiconazole Dicamba Glyphosate (Roundup®) Hexazinone	Tractor-pulled spray rig with boom	200
Acephate *B.t.* Esfenvalerate Picloram Propiconazole	Hydraulic sprayer with handheld wand	50
Esfenvalerate Dicamba Glyphosate (Roundup®) Hexazinone Picloram Triclopyr	Backpack sprayer	50
Potassium salts of fatty acids	Hand sprayer	50
Glyphosate (Rodeo®) ñ for invasive weeds only	Backpack, hand-held wick, injection	<20
Acephate Imidacloprid	Capsule implantation	50
Fertilizers	Broadcast spreader	50

[1] Does not apply to greenhouse applications.
[2] These buffer zones may be adjusted if drift monitoring results are obtained that demonstrate that either a reduced buffer would not introduce chemicals into the waterways or that a wider buffer is required. However, buffer widths will not be decreased during the term of the present NOAA-Fisheries opinion, which expires on December 21, 2009. After December 21, 2009, changes to buffer widths would be subject to further consultation with NOAA-Fisheries.

Terms and conditions:

Terms and conditions were specified by NOAA Fisheries during ESA consultation to implement reasonable and prudent measures. These are included in the limitations incorporated into Alternative B, the proposed action, and are provided, verbatim, below.

Reasonable and Prudent Measures

Reasonable and Prudent Measures are non-discretionary measures to avoid or minimize take that must be carried out by cooperators for the exemption in section 7(o)(2) to apply. The BLM has the continuing duty to regulate the activities covered in this incidental take statement where discretionary Federal involvement or control over the action has been retained or is authorized by law. The protective coverage of section 7(o)(2) may lapse if the BLM fails to exercise its discretion to require adherence to terms and conditions of the incidental take statement, or to exercise that discretion as necessary to retain the oversight to ensure compliance with these terms and conditions.

The NOAA Fisheries believes that the following reasonable and prudent measures are necessary and appropriate to minimize take of listed species resulting from completion of the proposed action.

The BLM shall:

1. Minimize incidental take by ensuring that orchard pests are managed using integrated pest management techniques that use treatment thresholds and minimize the need for pesticide application.
2. Minimize incidental take from pesticide applications by choosing pesticide formulas, timing, place, and manner of pesticide use to minimize the likelihood of delivery to riparian and aquatic systems.
3. Minimize incidental take from fertilizer application by ensuring that fertilizer is applied in a time, place and manner that minimizes the likelihood of delivery to surface and groundwater.
4. Ensure completion of a annual comprehensive monitoring and operations reporting program to confirm this Opinion is meeting its objective of minimizing take from permitted activities.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the BLM must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary and, in relevant part, apply equally to proposed actions in all categories of activity.

1. To implement Reasonable and Prudent Measure #1 (integrated pest management) the BLM shall:

   a. Treatment Thresholds. Ensure that no action to suppress insect pests will be taken unless pest monitoring show that one or more pests have reached a threshold at which losses in seed yield and quality exceed the economic and environmental cost of treatment. No pesticide will be applied on a routine basis, without regard for treatment thresholds based on pest populations.

   b. Prescribed Burning. When prescribed burning will be used as a pest control, the following conditions will apply.

      i. Design the prescribed burn to minimize disturbance of riparian ground cover and vegetation, and any other habitat characteristic that could be damaging to long-term ecosystem function.
      ii. Ensure that all vehicles, including emergency equipment, are not operated, maintained and stored next to any stream, waterbody or wetland. Equipment shall not disturb native riparian vegetation.
      iii. Ensure that all vehicles, including emergency equipment, are not fueled within

150 feet of any waterbody.

iv. If riparian areas are inadvertently damaged during a prescribed burn, immediately prepare and implement a rehabilitation plan designed to restore riparian ground cover and vegetation.

v. Appropriate fire suppression equipment shall always be at the project site during a prescribed burn.

c. Each supervisor engaged in IPM activities must be informed of the following requirement:
NOTICE: If a sick, injured or dead specimen of a threatened or endangered species is found, the finder must notify the Vancouver Field Office of NOAA Fisheries Law Enforcement at 360.418.4246. The finder must take care in handling of sick or injured specimens to ensure effective treatment, and in handling dead specimens to preserve biological material in the best possible condition for later analysis of cause of death. The finder also has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not disturbed unnecessarily.

2. To implement **Reasonable and Prudent Measure #2** (use of pesticides), the BLM shall ensure that:

a. *Spill Prevention Plan and Methods.* Prepare and carry out a spill prevention plan to prevent contamination from spill of pesticides and other hazardous materials. The plan will contain the pertinent elements listed below, meet requirements of all applicable laws and regulations, and must be available for inspection on request by NOAA Fisheries.

i. The name and address of the party(s) responsible for accomplishment of the spill prevention plan.

ii. A description of any regulated pesticide and other hazardous materials that will be used as part of the IPM Plan.

iii. Training and certification for those who will be involved with pesticide transportation, storage, use, disposal, record keeping, monitoring, and emergency response.

iv. Practices to prevent spills associated with mixing sites (i.e., containment), critical areas where spills are likely to occur, and environmental restrictions.

v. Spill containment and notification procedures, specific cleanup and disposal instructions for different products, quick response containment and cleanup measures that will be available onsite, proposed methods for disposal of spilled materials.

b. *Timing of Pesticide Application.* Time pesticide applications as follows.

i. Prioritize applications for mornings or evenings when pollinators are not active (as seasonally applicable) in accordance with the best overall weather period.

ii. Weather. Pesticides shall not be applied under the following weather and soil conditions unless the product label specifically recommends otherwise.

(1) Within 72 hours of predicted precipitation that would result in runoff and measurable increases in streamflow. To predict this, use a combination of precipitation forecasting, antecedent soil moisture conditions and current streamflows. These methods shall be documented and included in the annual monitoring report.

(2) In areas with standing water and saturated soils.

(3) In unstable air situations that may affect spray pattern or lead to offsite movement of spray, such as high air temperatures, during temperature inversions.

c. *Areas of Pesticide Application.*

i. Application Buffers. Application methods shall be restricted by zones as follows. Zone widths refer distances from any intermittent or perennial stream or water body with flowing water, measured horizontally from, and perpendicular to, the bankfull elevation, the edge of the channel migration zone, or the edge of

any associated wetland, whichever is greater. These buffer widths shall not be decreased over the five-year term of this Opinion.

(1) <20 Feet. Cultural methods, backpack, hand-held wick, injection using the Rodeo® formulation of glyphosate.

(2) >50 Feet. Capsule implantation, hand sprayer, and hydraulic sprayer with handheld wand.

(3) >200 Feet. All of the above, and tractor-pulled spray rig with boom, high-pressure hydraulic sprayer, airblast sprayer, and aerial methods.

3. To implement **Reasonable and Prudent Measure** #3 (use of fertilizers), the BLM shall ensure that:
   a. Fertilizer will not be applied within 50 feet of any stream, wetland or other waterbody.
   b. Fertilizer will be applied at agronomic rates.[1]
   c. Fertilizer loading (pertaining to application equipment) areas shall be at least 100 feet from perennial streams.

4. To implement **Reasonable and Prudent Measure** #4 (monitoring and reporting), the BLM shall ensure that:
   a. *Annual monitoring report.* All water quality monitoring information associated with application of the Horning Seed Orchard IPM program shall be compiled, analyzed, documented, and reviewed on a 'water year' basis. This 'water year' shall include all monitoring performed during the October 1 to September 30 period. This information, along with any recommendation for adjustments to protection measures and adjustments to the monitoring plan, shall be contained in an Annual Horning Seed Orchard Monitoring Report. This report shall be available to the public and regulatory agencies on November 15 of each year and be on file at the Horning seed orchard. This report shall include the following information:
   i. Project Identification.
      (1) BLM contact person.
      (2) Pesticide project manager.
      (3) Starting and ending dates for work completed.
   ii. IPM Documentation.
      (1) Description of how treatments were based on weather and pest monitoring.
      (2) A description of the biological and cultural pest controls used before pesticides were applied, or the reasons that biological and cultural controls were not used. Note that this provision is applicable to initial decisions to apply pesticides in response to pest population levels, not each individual application, and shall be documented within the annual monitoring report.
   iii. Pesticide Use History.
      (1) Type of chemical applied.
      (2) Date of application.
      (3) Buffers present.
      (4) Method of pesticide application.
      (5) Total area treated.
      (6) Amount of pesticide applied.
      (7) Precipitation for the three days preceding and following application.
      (8) Wind direction and speed, relative humidity, air temperature at time of application.
      (9) Location used for mixing and loading and notes regarding whether any leakage or spills occurred.
   iv. Effectiveness Monitoring.
      (1) Orchard units or treatment areas within 200 feet shall have drift cards placed at a maximum of 50-foot intervals along the edge of Horning's unit before the application (for aerial, airblast and high pressure hydraulic sprayer applications), whenever liquid pesticides are applied. Applications shall cease if there is any indication that chemicals are moving out of the target area.

[1] 'Agronomic rate' means a quantity and timing of total nutrient application that does not exceed the requirements of the crop production and harvest or grazing system, as opposed to a nutrient application rate based on production goals that are difficult to define and variable. Calculation of the agronomic rate takes into account the total nitrogen or phosphorus resources for plant nutrition, and any retention of phosphorus in the soil and losses of nitrogen through denitrification and ammonia volatilization

(2) If open canopy occurs in the waterway buffer, drift cards shall be selectively placed along the waterway edge to characterize potential intrusion of drift toward waterways. Any applications shall cease if there is any indication that there is off-target delivery occurring.

v. Surface Water Monitoring to Detect Drift.

(1) For aerial, airblast and high-pressure hydraulic sprayer applications of chemicals, water samples shall be collected before and after spray application that include representative '15 minute' and 24-hour (composite)' post treatment water samples.

(2) Surface water samples are collected within the project area, also, where appropriate, collect water samples concurrently where flowing water enters the project area to facilitate a baseline/cumulative concentration analysis.

Surface drift monitoring shall occur for the following compounds that are applied using thesespecific methodologies:

Application Method	Compound	Surface Water Drift Monitoring
Aerial	Esfenvalerate	A representative stream[2] or streams will be sampled and tested for each application
Airblast Sprayer High pressure hydraulic sprayer High pressure hydraulic sprayer w/ handheld wand	Esfenvalerate Chlorpyrifos Permethrin Diazinon Dimethoate Propargite Chlorothalonil	Surface water sampling and testing for each application within 300 feet of surface water
Backpack Sprayer - Hand-held wand	Esfenvalerate	Surface water sampling and testing for each application within 100 feet of surface water

vi. Cumulative Concentrations Runoff.

(1) Stormflow with the highest potential for chemical presence shall be sampled and, during these flow events, samples shall be composited according to the rise and fall of the hydrograph.

(2) SPMDs shall be deployed to sample initial winter storms and spring storm periods after pesticide application.

(3) The SPMDs shall be tested for those pesticides that were applied that can be accurately sequestered.

(4) SPMDS shall be strategically deployed in timeframes that are representive of potential exposure scenarios, such as runoff from significant rain events and or drift during application. SPMDS shall be deployed for approximately 30 days, though smaller time

(5) increments are encouraged because they are more sensitive to pulses of pesticides.

Horning monitoring locations for runoff and SPMD placement shall be at the following sites.

Sites related to surface runoff	Sites related to SPMD placement	Sites related to tile monitoring
Section 23; (site 9c) Ph-2, beside I-33 I-33 B-51 P-32	Section 23, above and below the SPMD B-51 I-33 Ph-2 beside I-33	B-12 B-14 (tile site 3) I-33 I-10 (tile site 2) Control (tile site 1)
Section 23; (site 11a) I-12 I-11 I-33 Ph-2 I-10	Section 13 SPMD: Stream 5 and 2 B-30, B-11, B-50, B-15, B-12, B-14	

Note: For Orchard Unit numbers referenced above, see page 85 and 86 of the Horning Biological Assessment.

[2] A representative stream is any stream beside a spray unit, downwind of a spray unit, or otherwise likely to be affected if drift outside the treatment units occurs.

vii. Monitoring of Best Management Actions. For select sites, monitoring shall be used to validate the water quality modeling predictions presented in the EIS and BA.

(1) Monitoring of stream 9c shall identify the effectiveness of protection measures, and to help to gauge the estimates in the RA.

(2) Concentrations shall be compared with modeled results utilizing field- and climate-specific data to validate RA estimates.

(3) If detectable concentrations are found, stream concentrations shall also be compared to model results using actual application information, field-specific data, and continuous climate record. These data shall provide a relationship between previous monitoring results and the management that is planned for the future. Once the yearly application period is complete, the climate record collected during that period shall be used to model a predicted concentration using the GLEAMS and MOC models. These concentrations shall be 'diluted' using the continuous flow data from the station. The resulting concentrations shall be compared with the actual measured concentrations for each storm event sampled.

(4) A collection chamber shall be installed where there is overland flow in unit P-11. During the first overland flow event following select chemical applications, this site shall be visited, and a water sample taken from the collection chamber, these data shall be used to assess the mobility of chemicals that have been used on-site within the past year.

viii. Spill Monitoring. In the event of a chemical spill, the volume of spill, proximity to water, and chemical characteristics, such as toxicity and mobility, shall be immediately evaluated to determine if water sampling is desirable and necessary. If the spill occurs in an area that is reasonably certain to deliver to surface waters, either immediately, or on the next precipitation event, sampling shall occur, as appropriate.

(1) Water samples shall be collected in a sufficient number and at surface water and groundwater locations that shall allow characterization of impacts and effective remediation methods. Depending on ODEQ Monitoring Hazardous Substances Remediation Rules (OAR 340-122), monitoring could include surface water, groundwater, air, and soil.

ix. Groundwater Monitoring. The domestic well at Horning shall be monitored for groundwater contamination. These samples shall occur annually, and normally be collected in late summer and handled according to state-certified laboratory instructions.

(1) Groundwater monitoring wells associated with the greenhouse effluent field shall be monitored. Water quality sampling shall be conducted when risks are highest for irrigation water to potentially reach the local ground water table. If 'point in time' samples are found to have detectible levels of the pesticide, SPMD's shall also be deployed in selected wells toallow a more quantitative determination of concentration over time.

(2) Notification of Discharge. If a surface water discharge occurs, the BLM shall notify NOAA Fisheries within 10 business days of detection. Notification shall include the type, location, and concentration of the discharge.

x. Circumstances that would trigger reinitiation:

(1) More than one discharge per zone, as defined in this Opinion, between the 'low trigger' and high trigger; values (within any one year). Note that discharges below the low trigger value are not applicable to this total.

(2) A discharge within any one year above the 'high trigger' value.

(3) For compounds with a common mode of action (i.e. pyrethroids and organophosphates), if the sum total of the toxic units is >0.05 (equivalent to 1/20th of the standardized LC_{50}'s) it will be counted as a 'low trigger' exceedence. If the sum total of the toxic units is > 0.5 (equivalent to ½ of the standardized LC_{50}'s) it will be counted as a 'high trigger' exceedence. This applies only when both detections occur in the same location, and at the same time (the compounds co-occur in the water column). The toxic units for each class, pyrethroids, and organophosphates, will be calculated as outlined within this Opinion. Only one 'low

trigger' exceedence will be counted if there is a toxic unit 'low trigger' exceedence for a particular chemical family that contains a 'low trigger' exceedence of an individual compound within that same chemical family.

(4) To account for the synergistic action of pyrethroids and organophosphates, as described within this Opinion, an exceedence of a 'low trigger' of both a pyrethroid and an organophosphate (either individually or as a sum total of family toxic units) will be considered the equivalent of exceeding a high trigger. This applies only when both detections occur in the same location, and at the same time (the compounds co-occur in the water column), and includes SPMD data.

(5) Upon any SPMD detection, the data shall be used to provide a 24-hour average waterborne contaminant concentration for the chemicals that were applied and can be sequestered. To reflect the margin of error within the SPMD methodology, a 2-fold safety factor shall be applied to the back calculated 24-hour average concentration (multiply the value by two). The corrected 24-hour concentration shall then be treated as a discharge within the final monitoring plan and the same circumstances apply for reinitiation.

(6) An annual review of SPMD data collection, data use, and sampling methodology may occur. In the event of a detection, factors leading to the resultant discharge concentration shall be reviewed.

b. *no subsection* "b" was included in NOAA's Biological Opinion

c. *Annual Operation Report.* The Annual Operation Report will be submitted to NOAA Fisheries by December 1st, and include the following information (NOAA Fisheries will review the Annual Operation Report within 30 business days of its receipt, note that the annual operations plan for 2005 only needs to include data specified within number (5)):

i. The results of the previous year monitoring program. If a discharge occurred during the previous year, possible causes of the discharge shall be explored, as well as future mitigation steps to prevent like discharges in the future.

ii. A data review of the pesticides that are proposed for use, or may be used, at Horning in the following year. The review shall include:

(1) New scientific data regarding non-target fish species effects or environmental fate.

(2) Changes to EPA-approved labels (ESA-approved and other).

(3) A review of legal findings relevant to the use of pesticides.

(4) A plan for proposed pesticide applications for the following year, including, to the extent possible, units or acres to be treated, proposed pesticide, application rate and method, dates, and a proposed monitoring plan covering the locations and pesticides to be monitored.[3]

(5) Any proposed changes to the IPM, including new limitations, protection measures, or mitigation measures as part of an adaptive management approach; the use of pesticides in addition to those proposed; or other relevant information.

(6) The annual report shall be sent to:

State Director
NOAA Fisheries
Oregon Habitat Branch
Attn: Michael P. Tehan
525 NE Oregon Street
Portland, OR 97232

d. *Annual Coordination.* Meet with NOAA Fisheries by January 15, each year as necessary, to discuss the annual monitoring report and any action necessary to make the program more effective.

[3] The draft monitoring plan shall include specific proposed sampling locations, frequencies, and methods in relation to the application plan.

During calcium nitrate application, orchard employees would be vigilant for nests of ground-nesting bird species, particularly the Oregon vesper sparrow and common nighthawk, to avoid applying fertilizer to any nests.

- The terms and conditions specified by NOAA fisheries during the ESA consultation process are incorporated as additional limitations into Alternative B, the proposed action, and re presented in full in the next subsection.

How is Alternative B Different from Alternative A?

Under Alternative B, all of the same pest control methods are available to the seed orchard manager as under Alternative A. However, Alternative B contains specific limitations (see list above) on certain aspects of chemical pesticide and fertilizer use to provide added protection to human health and the environment. Commonly, during the preparation of an EIS, the analysis of impacts occurs wholly during the EIS development process. In the case of the proposed IPM program at Horning, a quantitative risk assessment of the proposed chemical pesticides and fertilizers was completed *before* development of the EIS alternatives. The assumptions made during this risk assessment correspond to the pesticide application details of Alternative A. The conclusions of this assessment, and the interaction among the interdisciplinary team members during the assessment, directly resulted in developing a new alternative—Alternative B—that addresses all the predicted risks in the risk assessment scenarios, and protects resources based on these experts' site-specific knowledge of overall potential chemical transport pathways at the seed orchard. Alternative B, as the proposed action, also includes the terms and conditions identified by NOAA Fisheries during consultation under Section 7 of the ESA.

What are Limitations, Protection Measures, and Mitigation Measures?

These three concepts may seem similar, but they have distinct definitions within this EIS:

Limitations are the list of exceptions in Section 2.3.3 that distinguish the details of potential pesticide and fertilizer applications under Alternative B from those under Alternative A. These limitations were designed by the interdisciplinary team preparing this EIS to address predicted risks, respond to scoping concerns, and provide additional environmental protection. Limitations include the terms and conditions specified by NOAA fisheries during ESA consultation; these requirements are inherent in alternative B, the proposed action.

Protection measures are best management practices (BMPs), including BMPs for water quality protection under the *Clean Water Act*,[1] that would be implemented during any use of chemical pesticides by Horning, regardless of the alternative selected. Protection measures are listed in Section 2.3.1.

Mitigation measures are defined by CEQ (40 CFR 1508.20) as (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; or (e) compensating for the impact by replacing or providing substitute resources or environments. Mitigation measures are not specifically included in an alternative, but are additional measures in response to the potential environmental impact(s) that an alternative may have. Potential mitigation measures for the alternatives in this EIS are listed in Section 4.12, and, if needed, would be specifically identified in the ROD to correspond to the selected alternative.

[1]BMPs in relation to water pollution are defined by EPA as "methods that have been determined to be the most effective, practical means of preventing or reducing pollution from non-point sources."

2.3.4 Alternative C—Ground-Based IPM

Alternative C would be identical to the proposed action (Alternative B) except that the option to apply esfenvalerate by helicopter, as identified in Table 2.2-1, would be eliminated. Thus, under Alternative C, the seed orchard manager would be permitted to use any of the biological, prescribed fire, cultural, ground-based chemical, or other methods included in Alternative B. Esfenvalerate could be applied by an airblast sprayer, a high-pressure hydraulic sprayer, a hydraulic sprayer with a hand-held wand, or a backpack sprayer.

2.3.5 Alternative D—Non-Pesticide Pest Management

Alternative D would allow the seed orchard manager to use only the non-pesticide biological, prescribed fire, cultural, and other methods listed under Alternative A. No biological or chemical pesticides would be permitted.

2.3.6 Alternative E—No Action: Continue Current Management Approach

Alternative E would allow continuation of the current management system, which is the use of all non-pesticide pest control practices at the seed orchard, as well as the use of pesticides on a specific case-by-case basis. All non-pesticide biological, prescribed fire, cultural, and other methods would be used in accordance with current procedures. When a specific need is identified for a pesticide, the action would be reviewed to determine whether it is encompassed by an existing NEPA document. For example, weed control projects could be within the scope of the Northwest Area Noxious Weed Control Program EIS and Supplemental EIS, and the EIS for Vegetation Treatment on BLM Lands - Thirteen Western States. Section 1.4.1 provides more information on existing NEPA documents related to pest management. When specific proposed pesticide applications are not within the scope of an existing EA or EIS, another NEPA document would be prepared. This would include applications for cone insect control, control of other orchard insect outbreaks, disease infestations, and any vegetation control necessary that is not covered by other BLM vegetation control NEPA documents. (Using this approach, project-specific EAs were prepared for esfenvalerate use to spray for cone and seed insects in production orchards in 1999, 2000, 2001, and 2002.)

2.3.7 Alternative Considered But Not Further Analyzed

During the scoping process, one member of the public suggested planting more crop trees than necessary to allow for some loss to pests, which was interpreted as a request to consider no pest management at all. This is not a viable alternative for several reasons. First, this approach could lead to a significant loss of the crop trees in the production units if disease were to occur. Secondly, orchard research has shown that approximately 70% of the seed crop could be lost if no pest management were practiced (Schowalter et al. 1985). To partially offset the effects of cone and seed insects and decreased tree vigor due to disease, it would be necessary to plant production trees in fields that are currently fallow, as the commentor suggested. This solution would require the seed orchard and their cooperators to accept an estimated 10-year reduction in seed production, which is the time that would be required for the newly planted trees to produce collectable seed. This decrease in production could also result in delays in reforestation projects caused by potential seed shortages, or reduced forest growth resulting from the use of genetically inferior seed from other sources. In addition, a more intensive planting regime on seed orchard lands, with no pest management of any kind, would allow the orchard grounds

to become a "reservoir" for insects, disease, noxious weeds, and animal pests that would spread to neighboring public and private lands—effectively, becoming a threat and nuisance to the neighbors, particularly those who cultivate crops of their own.

2.4 Approval of New Products and Technologies

It is likely that, over the life of the proposed IPM program, BLM seed orchard personnel will become aware of chemicals or non-chemical control methods that are currently available but were not described in this EIS, or that represent new technologies not currently available or practiced. This section describes how BLM would ensure compliance with U.S. laws (including NEPA) and regulations, and evaluate these new approaches for inclusion in the seed orchard's pest management plans, in terms of both their efficacy and their potential environmental impacts. This information applies both to full-scale use as a control method, as well as to field research projects investigating the potential for larger applications.

This approach includes descriptions of how new chemical products or technologies would be examined for consideration by BLM, what data would be relied upon to assess a product or technology's effectiveness for use on public lands, what data would be relied upon to conduct human health hazard and risk assessment, and the level of NEPA documentation required to support a decision to use or not use a product or technology.

2.4.1 Identification of New Chemical Products and Technologies

The seed orchard manager and employees may become aware of new pest control products and technologies through three general mechanisms: professional networking, technical research and publications, and vendor marketing.

Networking

Participation in professional networks is the principal method for staying current on new pest control approaches, and yields information on the technical, regulatory, efficacy, and environmental aspects of methods, both those in the development phase and those currently on the market. The primary professional association for BLM seed orchard managers in Oregon is the Northwest Seed Orchard Managers Association (NWSOMA), and particularly its Northwest Pest Management Committee. For nursery and greenhouse managers, the primary professional associations are the Western Forest and Conservation Nursery Association and the Intermountain Container Seedling Growers Association.

The Southwest Oregon Forest Insect and Disease Service Center is a group of U.S. Forest Service pathologists and entomologists that provide forest insect and disease technical assistance, field consultation, modeling, risk assessments, and historical information to Federal resource managers in southwest Oregon. A field service center is located near BLM's Medford District seed orchards at the Forest Service's J. Herbert Stone Nursery in Central Point. Similar services are also available in the Forest Service's regional office in Portland.

Useful information can also be obtained by staying in contact with other non-regional professional networks with similar goals, such as the Southern Seed Orchard Pest Management Subcommittee of the Southern Forest Tree Improvement Committee (part of the North Carolina State University Industry Cooperative Tree Improvement Association). Similarly, the British Columbia Seed Orchard Association, which often has formal interactions and collaborations with NWSOMA, is another professional network focusing on seed orchard management.

Technical Research and Publications

The U.S. Forest Service conducts extensive research activities that support tree improvement and re-forestation activities. The web page USDA/FS Research Publications (http://216.48.37.142/) provides a search function that indexes Forest Service research publications, by keyword or by research station.[8] The Forest Service's Reforestation Nurseries and Genetics Resource web page (http://www.rngr.fs.fed.us/) includes current information on seed orchard and tree nursery practices and pest management.

The IR-4 Ornamentals Research Program, organized by the state land grant universities and the U.S. Department of Agriculture (USDA), assists in collecting data that can be used to add minor crop (including seed orchard tree species) uses to existing chemical and biological pesticide registrations. The program's activities are described in detail at its web site (http://pestdata.ncsu.edu/ir-4/).

The Washington State Commission on Pesticide Registration is a state-funded regional program with a similar mandate (http://wscpr.org/).

Vendor Marketing

Vendors of pest control technologies, including chemical company representatives, occasionally contact BLM's seed orchards to introduce new products. These contacts may come in the form of mailed brochures or advertisements, or telephone contacts to request a visit to the seed orchard.

From time to time, members of the public who are interested in various approaches to pest management send information to the seed orchard manager describing these methods. As with pest control methods identified through other avenues, if the seed orchard manager determines that the approach may have some utility for the seed orchard's needs, a product demonstration or additional information may be requested.

2.4.2 Assessment of Effectiveness

The seed orchard manager would be the one to judge whether a previously unconsidered pest control product or technology is likely to be effective in meeting the specific seed orchard's pest control needs. The decision would be based on details such as previous use reports at other sites and their outcomes, availability, cost, expected effectiveness compared to any currently used methods, training and personnel requirements, factors that could limit efficacy, and any other relevant factors (including hazards and risks—see Section 2.4.3 below).

Any new chemical or biological pesticide considered for use by the seed orchard must be registered under FIFRA, which requires product performance data relating to its effectiveness. This requirement was designed "to ensure that pesticide products will control the pests listed on the label and that unnecessary pesticide exposure to the environment will not occur as a result of the use of ineffective products" [40 CFR 158.202(i)]. Therefore, any new pesticide registered under FIFRA is expected to be generally effective for the labeled uses. To further assess the potential for site-specific effectiveness prior to an actual application in the seed orchard, the seed orchard manager would investigate its use through professional networks, technical publications, and/or research reports, such as those described in the previous section.

[8] This and other Internet citations (uniform resource locators, or URLs) in this EIS were accurate at the time of publication. However, websites change frequently due to changes in data availability or reorganization of information, and the cited URLs may not work in the future. If this occurs, "backing up" to a less specific web address or using an Internet search function may allow retrieval of the information.

For a pest control technology that is not required to be registered under FIFRA, the avenues of research described in the previous section would be the likely initial means for discovering its advantages and limitations over currently used methods. This could pertain to cultural control practices, tools or equipment, or other means that are not considered pesticides under the purview of FIFRA.

2.4.3 Assessment of Hazards and Risks

As stated in the previous section, BLM only uses pesticide products that are registered under FIFRA. Therefore, for any chemical or biological pesticide that may be considered for use in the seed orchard, there would exist a body of EPA-reviewed toxicological, environmental fate, and ecotoxicity data that were submitted by the pesticide manufacturer to support its registration application. These data can be used to conduct a site-specific assessment of the potential human health and ecological risks from the pesticide's use at the seed orchard, including the following components:

- Identification of potential use patterns, including target pest(s), formulation, application method(s), locations to be treated, application rate, and anticipated frequency.

- Review of chemical hazards relevant to human health risk assessment, including systemic and reproductive effects, skin and eye irritation, dermal absorption, allergic hypersensitivity, carcinogenicity, neurotoxicity, immunotoxicity, and endocrine disruption.

- Estimation of exposure to workers applying the chemical or re-entering a treated area.

- Environmental fate and transport, including drift, leaching to groundwater, and runoff to surface streams and ponds.

- Estimation of exposure to members of the public.

- Review of available ecotoxicity data, including hazards to mammals, birds, reptiles, amphibians, fish, and aquatic invertebrates.

- Estimation of exposure to terrestrial and aquatic wildlife species.

- Characterization of risk to human health and wildlife.

If the available toxicity or ecotoxicity data are inconclusive, or substantial disagreement occurs among the results of technical studies that could affect the potential risk conclusions for the chemical, BLM could conduct a formal peer review of the available scientific information to develop a consensus as to the endpoint(s) in question. The peer review process would include the following steps, based largely on EPA's peer review process (EPA 2000b):

- BLM would conduct a literature search of studies submitted to EPA, studies published in professional journals, and research projects conducted by other government agencies or universities. The identified literature would be indexed and abstracted.

- A peer review committee would be formed, consisting of reviewers with recognized technical expertise that bears on the subject matter under discussion, who represent a balanced range of technically legitimate points of view, and who do not have any real or perceived bias or conflict of interest. The peer reviewers would be supplied with their charge, the results of the literature review, and a description of the issue at hand.

- The input of each reviewer would be sent to BLM. If the results of the peer review are not consistent at this point, a working session would be convened, in which the peer reviewers would come together to discuss the technical aspects of the questions and attempt to reach a consensus.

The details of the peer review process would be determined by the question to be answered and the nature of the controversy. To the extent they are relevant, the guidelines and processes in EPA's *Peer Review Handbook* (EPA 2000b) would be followed.

For assessment of the hazards and risks from non-pesticide methods (biological controls, cultural controls, and other methods), BLM would review the potential for impacts to worker health and safety, public health and safety, and special status[9] species and their habitat. Limited-scale field trials could assist in identifying potential hazards from a non-pesticide method under consideration, as well as in determining the effectiveness of any new approach.

2.4.4 NEPA Documentation

The potential use of new technologies or products for pest control in the seed orchard would require a review to ensure compliance with NEPA. The review would follow the process outlined in the BLM NEPA Handbook (H-1790-1), Chapter 1 (BLM 1988), and would consist of the basic steps described below and outlined in Figure 2.4-1.

Step 1. Conduct a CX Review

The first step in this review is to determine whether the new action is within the scope of a Department of Interior or BLM categorical exclusion (CX) (516 DM 2, Appendix 1; and 516 DM 11.5, respectively) (DOI 1980). These two lists constitute *List C*, as identified in Figure 2.4-1. Based on an initial review of this list, there appear to be only two CXs, both within the Forestry areas on the BLM list, that have the potential to cover a new technology or product relating to seed orchard operations (516 DM 11.5 c (1) and (3)):

- Land cultivation and silvicultural activities (excluding herbicides) in forest tree nurseries, seed orchards, and progeny test sites.

- Seeding or reforestation of timber sales or burn areas where no chaining is done, no pesticides are used, and there is no conversion of timber type or conversion of non-forest to forest land. Specific reforestation activities covered include: seeding and seedling plantings, shading, tubing (browse protection), paper mulching, bud caps, ravel protection, application of non-toxic big game repellant, spot scalping, rodent trapping, fertilization of seed trees, fenced construction around out-planting sites, and collection of pollen, scions and cones.

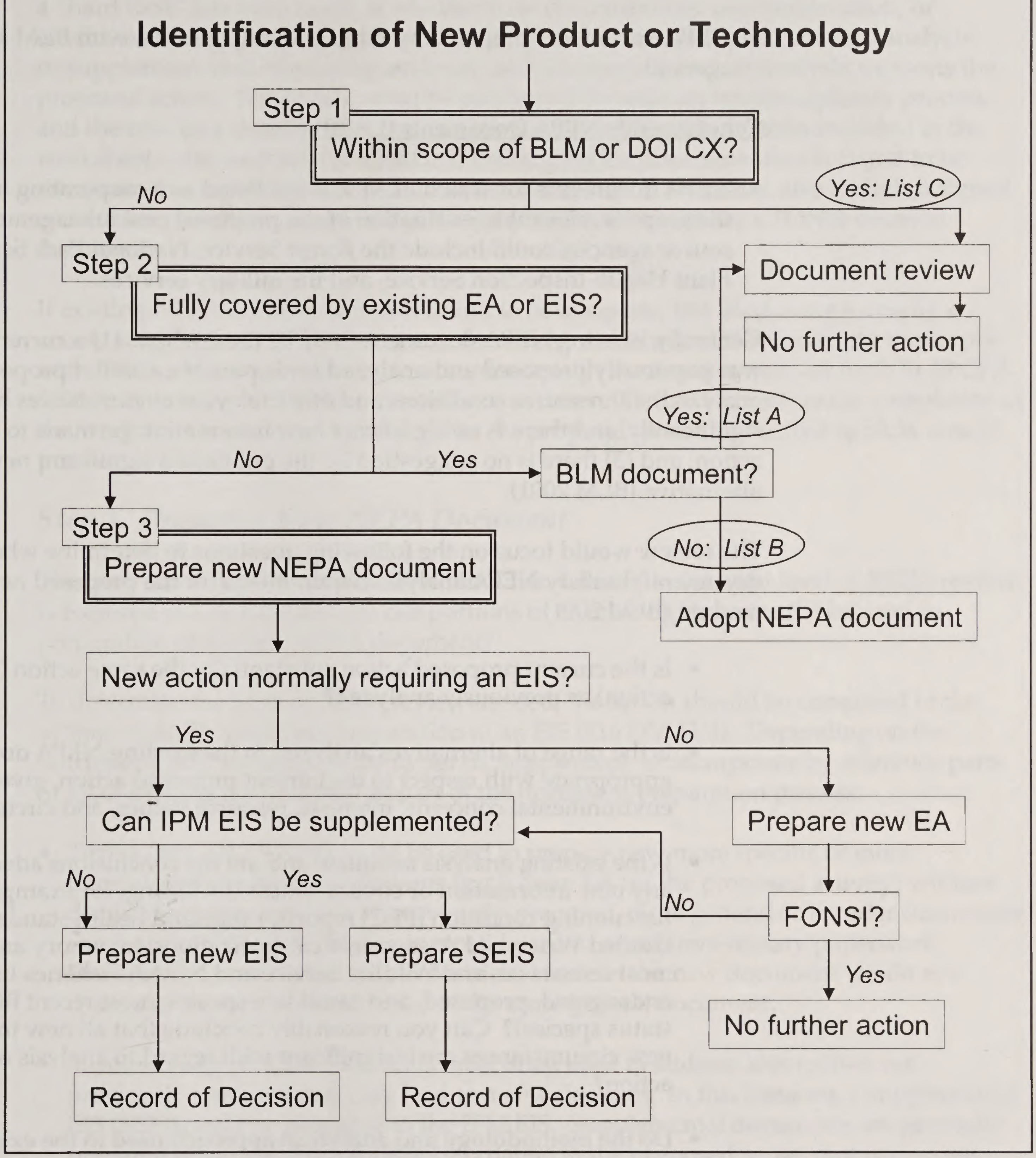
Therefore, some non-pesticide methods could be within the scope of an existing CX.

The CX review actually involves three steps: (1) ensure conformance with existing land use plan; (2) identify potential CX—see above; and (3) review the current list of exceptions to CX at 516 DM 2, Appendix 2.

If the new action is within the scope of a CX, and none of the exceptions applies, the CX review would be documented and then no further action would be required. If a CX was not identified or one or more of the exceptions were met, then BLM would proceed to **Step 2.**

[9] Special status species are species which are proposed for listing, officially listed as threatened or endangered, or are candidates for listing as threatened or endangered under the provisions of the *Endangered Species Act*; those listed by a state in a category such as threatened or endangered implying potential endangerment or extinction; and those designated by each BLM State Director as sensitive.

Figure 2.4-1. NEPA Review of New Products and Technologies



Step 2. Review Existing EAs and EISs

The following types of existing NEPA documents would be reviewed to determine whether any have fully covered the use of the proposed new product or technology:

<u>BLM NEPA Documents (List A)</u>

- This seed orchard-specific IPM EIS.
- EISs associated with the District RMP or Plan amendments.
- Programmatic documents such as the EIS for Vegetation Treatments, Watersheds and

Wildlife Habitats on Public Lands Administered by the BLM in the Western United States, Including Alaska (currently in preparation).

- Any seed orchard-specific EAs that have been prepared for pest management or operations.

- NEPA documents prepared by other Federal agencies, with BLM as a cooperating agency.

Other Agency NEPA Documents (List B)

- NEPA documents for which BLM was not listed as a cooperating agency, but for which the scope is relevant to evaluation of the proposed pest management method. Possible source agencies could include the Forest Service, National Park Service, Animal and Plant Health Inspection Service, and the military services.

Generally, existing NEPA documents may be used when: (1) a current proposed action was previously proposed and analyzed (or is part of an earlier proposal that was analyzed); (2) resource conditions and other relevant circumstances have not changed significantly, and there is no significant new information germane to the proposed action; and (3) there is no suggestion by the public of a significant new and appropriate alternative (BLM 2001).

The review would focus on the following questions to determine whether the existing document(s) satisfy NEPA analysis requirements for the proposed new pest management method (BLM 2001):

- Is the current proposed action substantially the same action (or is a part of an action) as previously analyzed?

- Is the range of alternatives analyzed in the existing NEPA document(s) appropriate with respect to the current proposed action, given current environmental concerns, interests, resource values, and circumstances?

- Is the existing analysis adequate and are the conclusions adequate in light of any new information or circumstances (including, for example, riparian proper functioning condition [PFC] reports; rangeland health standards assessments; Unified Watershed Assessment categorizations; inventory and monitoring data; most recent Fish and Wildlife Service and NOAA Fisheries lists of threatened, endangered, proposed, and candidate species; most recent BLM lists of special status species)? Can you reasonably conclude that all new information and all new circumstances are insignificant with regard to analysis of the proposed action?

- Do the methodology and analytical approach used in the existing NEPA document(s) continue to be appropriate for the current proposed action?

- Are the direct and indirect effects of the current proposed action substantially unchanged from those identified in the existing NEPA document(s)? Does the existing NEPA document sufficiently analyze site-specific impacts related to the current proposed action?

- Can you conclude without additional analysis or information that the cumulative impacts that would result from implementation of the current proposed action are substantially unchanged from those analyzed in the existing NEPA document(s)?

- Are the public involvement and interagency review associated with existing NEPA document(s) adequately [sic] for the current proposed action?

If all the criteria are met and the existing document is a BLM document or one with BLM as a cooperating agency, then the analysis and results would be documented using the Documentation of Land Use Plan Conformance and NEPA Adequacy, described in BLM Instruction Memorandum No. 2001-062 (BLM 2001). Reliance on existing NEPA documents requires the establishment of an administrative record that clearly shows a "hard look" has been taken at whether new circumstances, new information, or environmental impacts not previously anticipated or analyzed warrant new analysis or supplementation of existing analyses, and whether the impact analysis supports the proposed action. The review must be conducted through an interdisciplinary process, and the resulting documentation must adequately address the criteria included in the worksheet contained in BLM (2001). If existing NEPA documentation is found to be adequate, this must be documented on the worksheet, which must also include a signed conclusion statement. Approval of the proposed action requires a FONSI decision document.

If existing NEPA documentation is found to be adequate, but BLM is not formally a cooperating agency on the document, then BLM would adopt the document to comply with NEPA; adoption would be in accordance with the requirements set forth in 40 CFR 1506.3. If existing NEPA documentation was determined to be inadequate, completion of the worksheet is not required and either the proposal would be rejected or BLM would proceed to **Step 3**.

Step 3. Prepare a New NEPA Document

This step can be further broken down into two sub-steps: (a) what level of NEPA review is required (EA or EIS); and (b) can portions of an existing document(s) be used in preparation of the new NEPA document?

To determine the level of NEPA review needed, the action should be compared to the actions typically requiring preparation of an EIS (516 DM 11.4). Depending on the outcome, it may be appropriate to tier to, supplement, or incorporate by reference parts or all of existing document(s) as part of the document preparation process:

- *Tiering* (40 CFR 1508.28) could be used to prepare new more specific or more narrow environmental documents (such as an EA for the proposed activity) without duplicating relevant parts of previously prepared, more general or broader documents (such as the IPM EIS). Tiering is mostly used to avoid unnecessary paperwork. Documents can be tiered only if decisions made in the new document would not change or modify the decision(s) of the more general document.

- *Supplementing* (40 CFR 1502.9c) is most often used to address alternatives not previously analyzed and may lead to a new decision. In this instance, a supplemental EIS (SEIS) could be prepared to the IPM EIS. Supplemental documents are generally prepared when there is a substantial change in the proposed action that is relevant to environmental concerns; that is, if there are significant new circumstances or facts relevant to environmental concerns and bearing on proposed action or impacts that were not addressed in existing analysis. If the existing IPM EIS is supplemented, the same standard procedural and documentation requirements for EISs are followed (see Chapter 5 of BLM Handbook), except that additional scoping is optional. In addition, the SEIS must identify the EIS being supplemented and explain the relationship to the prior analysis early in the text. Further, the SEIS should identify changes in the proposed project and/or significant new information or changed circumstances that necessitate preparation of the supplement.

- *Incorporating by reference* (40 CFR 1502.21) is a technique used to avoid redundancies in analysis and to reduce the bulk of a NEPA document. An EA or EIS must identify the documents that are incorporated by reference and indicate where they are available

for public review. Relevant portions of the incorporated analysis must be referenced by page number, and summarized in the EA or EIS to the extent necessary to provide the decisionmaker and public with an understanding of significance of the referenced material to the current analysis. The new NEPA document must be able to stand alone.

Preparation of a new EA would follow the procedures outlined in the BLM NEPA Handbook, Chapter 4. Preparation of a new EIS or SEIS would follow the procedures outlined in the BLM NEPA Handbook, Chapter 5 (including, where appropriate, tiering, supplementing, and incorporating by reference, as noted above). The EA process would end in issuance of a FONSI or a determination of the need to prepare an EIS. The EIS process would end with issuance of a ROD.

2.5 Ongoing and Reasonably Foreseeable Future Actions in Study Area

Implementing the proposed action or an alternative at Horning would be concurrent with other actions at the orchard and adjacent lands; these actions could contribute to cumulative impacts to some resources. The seed orchard plans only routine operations, and expects no construction or other unusual activities that would contribute to cumulative impacts (BLM 2002).

On some properties adjacent to Horning, several companies conduct Christmas tree and other timber operations, including logging, the use of heavy machinery, and IPM activities. These companies apply chemicals using a variety of methods, including applications of granular fertilizer by helicopter and of chemical pesticides by tractor/boom and backpack sprayers. There are no other activities known to occur on adjacent properties that would contribute to cumulative impacts (BLM 2002).

2.6 Summary of Environmental Impacts by Alternative

Areas of potential concern for the proposed action and alternatives were identified based on input from BLM interdisciplinary team members, consultation with Federal and state agencies, scoping comments, and comparisons with similar activities. The potential impacts were evaluated and are described in Chapter 4.

As defined in CEQ's regulations for implementing NEPA, determining whether an environmental impact is "significant" requires consideration of both context and intensity. In the resource-specific subsections of Chapter 4 of this EIS, the criteria used to define each impact's significance are described under the sub-heading "Analysis Approach and Assumptions."

Table 2.6-1 summarizes the environmental impacts for each resource by alternative. Table 2.6-1 is provided as an attachment at the end of this chapter, following Table 2.2-1.

The resource-specific assessments in Chapter 4 are organized according to a logical flow of analysis. Effects on the physical environment (for example, surface water) must be determined before effects on the associated resources (such as aquatic species) can be assessed. This same sequence of resources is maintained in Table 2.6-1. However, scoping concerns would dictate a different priority for considering the results, in which the following five resources are of greater importance than the others for purposes of decisionmaking: human health and safety, water quality, wildlife and aquatic species, socioeconomics, and soils. The analysis predicted no significant impacts in two of these

areas: socioeconomics and soils. Comparison of potential impacts among the remaining three resources provides the critical information to be considered by the decisionmaker in preparing the ROD for this EIS:

Human Health and Safety

- There are no significant risks to members of the public from the proposed use of any of the control methods under any of the alternatives. However, under Alternatives A, B, C, and E, an accidental spill of pesticide to a stream could make surface water unsafe for drinking or fishing. Under Alternatives B and C, the probability of any accidental spill to surface water would be decreased by limits on pesticide transport over specific streams.

- Under Alternatives A and E, there is a possibility of health effects for workers from some chemical pesticides. No risks of worker health effects were predicted for pesticide applications under Alternatives B and C. Under Alternatives A, B, C, and E, an accidental spill onto the skin could cause health risks. Under all of the alternatives, there is a possibility of injury from cultural or prescribed fire methods.

Water Quality

- No significant impacts to groundwater quality were predicted under any alternative.

- Runoff or drift from pesticide applications could enter streams and rivers under Alternatives A, B, C, and E, as could runoff containing fertilizers under all alternatives. The effects of the estimated stream concentrations on human health and aquatic species are described under those headings. Under Alternatives B and C, limitations would be in place to control the potential for runoff and drift.

- An accidental spill of pesticide concentrate or mix could contaminate groundwater or surface water under Alternatives A, B, C, and E. Under Alternatives B and C, the probability of any accidental spill to surface water would be decreased by limits on pesticide transport over specific streams.

Biological Resources

- No significant adverse impacts to non-target vegetation are expected under any of the alternatives.

- There are possible risks to terrestrial wildlife species from three of the proposed insecticides under Alternatives A and E, and from calcium nitrate fertilizer under all alternatives. Lethality would be expected for non-target insects in an area treated with insecticide under Alternatives A, B, C, and E. With the exception of localized lethal impacts to non-target insects, no significant impacts to terrestrial wildlife were predicted under Alternatives B and C.

- There are no significant risks to aquatic species from use of chemical, biological, prescribed fire, or cultural control methods under any of the alternatives. Under Alternatives A, D, and E, there is a potential for sublethal impacts due to ammonium toxicity on special status aquatic species under maximum scenario conditions only. Under Alternatives A, B, C, and E, there could be adverse impacts to aquatic species from an accidental spill of pesticide to a stream. Under Alternatives B and C, the probability of any accidental spill to surface water would be decreased by limits on pesticide transport over specific streams.

Alternative B, the proposed action, is BLM's preferred alternative for minimizing long-term impacts to all resources, including human health.

Table 2.2-1. Pesticide and Fertilizer Application Summary[a]

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Insecticides					
Acephate: Acecap® 97 (97% a.i. in an implant capsule) *Target pests: root weevil, gypsy moth, tussock moth, Douglas-fir needle midge*					
Implants	Individual trees in any seed production or breeding & preservation orchard	1 capsule/4 inches circumference 1 application to 600 trees	1 capsule/4 inches circumference 1 application to 600 trees	Apr - May	Every 1 to 3 years
Acephate: Orthene® Turf, Tree & Ornamental WSP (75% a.i. in a water soluble bag) *Target pests: root weevil, gypsy moth, tussock moth, Douglas-fir needle midge*					
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand	Individual trees in any seed production or breeding & preservation orchard	0.01 lb a.i./tree, in water at 2 gal/tree 1 application to 600 trees	0.01 lb a.i./tree, in water at 2 gal/tree 1 application to 600 trees	Apr - Sep	Every 1 to 3 years
Hand sprayer	Greenhouses 1 and 2 and center-span	0.0075 lb a.i./gal, in water at 1 gal/100 ft^2 1 application to 3 tables (96 ft^2)	0.0075 lb a.i./gal, in water at 1 gal/100 ft^2 2 applications to 3 tables (96 ft^2)	Jun - Sep	Every 1 to 3 years
Acephate: 1300 Orthene® TR (12% a.i. in 4- or 12-oz. total release canisters) *Target pests: root weevil*					
Total-release canisters	Greenhouse	Two (4-oz.) cans per greenhouse 1 application to both greenhouses	Two (4-oz.) cans per greenhouse and one (4-oz.) can in center-span 2 applications to both greenhouses and center-span	Jun - Sep	Every 1 to 3 years

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
B.t.: Deliver® (18% a.i. as a wettable granular bioinsecticide) *Target pests: gypsy moth, Douglas-fir tussock moth, spruce budworm, tent caterpillar*					
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand	Any orchard	0.27 lb a.i./acre, in water at 100 gal/acre 1 application to trees on 75 acres	0.27 lb a.i./acre, in water at 100 gal/acre 1 application to trees on 150 acres	Apr - Sep	Every year of a harvestable cone crop
Chlorpyrifos: Dursban 50W (50% a.i. as a wettable powder in water-soluble packets) *Target pests: adelgids, Cooley spruce gall aphids, gypsy moth, Douglas-fir tussock moth, spruce budworm, Lygus spp., maple leaf cutters, oak skeletonizers, pitch pine moths, weevils, bark beetles*					
Airblast sprayer	Any orchard	1 lb a.i./acre, in water at 100 gal/acre 1 application to 75 acres	2 lb a.i./acre, in water at 100 gal/acre 1 application to 150 acres	Apr - Sep	Seldom: 1 to 2 times in a 10-year period
Diazinon: Diazinon 50W (50% a.i. as a wettable powder) *Target pests: two-spotted mites, aphids, budmoths, root weevils, tent caterpillars, obscure root weevil*					
High-pressure hydraulic sprayer	Individual trees in any orchard or in native plant beds	0.015 lb a.i./tree, in water at 3 gal/tree 1 application to 1,500 trees	0.075 lb a.i./tree, in water at 5 gal/tree 2 applications to 1,500 trees	Apr - Sep	Seldom: 1 to 2 times in a 5-year period
Dimethoate: Digon 400 (43.5% a.i. as a liquid concentrate) *Target pests: Douglas-fir cone moth, Douglas-fir cone gall midge, Douglas-fir seed wasp, cone worm*					
High-pressure hydraulic sprayer	Individual trees in any seed production orchard	0.13 lb a.i./tree, in water at 2 gal/tree 1application to 1,000 trees	0.34 lb a.i./tree, in water at 4 gal/tree 2 applications to 1,000 trees	Apr - Jun	Only if esfenvalerate was unavailable

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Esfenvalerate: Asana® XL (8.4% a.i. as an emulsifiable concentrate) *Target pests: Douglas-fir cone moth, cone worm, seed bug, seed chalcid, pine conelet bug, pine needle midge, spruce budworm, balsam woolly adelgid*					
Aerial (helicopter)	Seed production orchards	0.19 lb a.i./acre, in water at 10 gal/acre 1 application to 75 acres	0.19 lb a.i./acre, in water at 10 gal/acre 2 applications to 150 acres	Apr - Jul	Annually, rotating among units
Airblast sprayer	Seed production orchards	0.05 lb a.i./acre, in water at 100 gal/acre 1 application to 75 acres	0.088 lb a.i./acre, in water at 175 gal/acre 2 applications to 150 acres	Apr - Jun	
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Individual trees in any orchard	0.001 lb a.i./tree, in water at 2 gal/tree 1 application to 1,000 trees	Cumulative maximum = 1.6 lb a.i./acre per year 0.002 lb a.i./tree, in water at 4 gal/tree 2 applications to 1,000 trees	Apr - Jun	
Horticultural Oil: Dormant Oil 435 (98.8% paraffinic hydrocarbon oil) *Target pests: spider mites, scales*					
High-pressure hydraulic sprayer	Individual trees in any orchard, as an additive to other insecticides, fungicides, or miticides; or alone as a dormant spray	0.03 gal oil/tree, in water at 3 gal/tree 1 application to individual trees on 10 acres	0.05 gal oil/tree, in water at 5 gal/tree 2 applications to individual trees on 10 acres	Mar - Sep (as an additive) Sep - May (as a dormant oil)	Every 1 to 2 years as an alternate or supplement to non-chemical treatments

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Imidacloprid: Imicide® (10% a.i. in an implant capsule) *Target pests: Douglas-fir gall midge, coneworm*					
Implants	Individual trees in any seed production or breeding & preservation orchard	1 3-mL capsule/4 inches circumference at breast height 1 application to 500 trees on 10 acres	1 3-mL capsule/4 inches circumference at breast height 1 application to 6000 trees on 120 acres	Jan - Mar	Annually, rotating among orchard units
Permethrin: Pounce® 3.2 EC (38.4% a.i. as an emulsifiable concentrate) *Target pests: Douglas-fir coneworm, seed bug*					
Airblast sprayer	Pine orchards	1.05 lb a.i./acre, in water at 100 gal/acre 1 application to 9 acres	1.05 lb a.i./acre, in water at 100 gal/acre 2 applications to 9 acres	May - Aug	Only if esfenvalerate was unavailable
High-pressure hydraulic sprayer	Individual trees in pine orchards	0.01 lb a.i./tree, in water at 5 gal/tree 1 application to 900 trees	0.02 lb a.i./tree, in water at 10 gal/tree 2 applications to 900 trees	May - Aug	
Potassium salts of fatty acids: Safer® Soap (49.0% a.i. as a ready-to-use liquid) *Target pests: aphids*					
Hand sprayer	Greenhouse, individual trees or tree branches in any orchard	As needed	As needed	Apr - Sep	Every 1 to 2 years as an alternate or supplement to non-chemical treatments
Propargite: Omite® CR (32% a.i. as a wettable powder in water soluble bags) *Target pests: spider mites*					
High-pressure hydraulic sprayer	Individual trees in any orchard	1.4 lb a.i./acre, in water at 100 gal/acre 1 application to 20 acres	2.4 lb a.i./acre, in water at 100 gal/acre 2 applications to 20 acres	Apr - Oct	1 to 2 times in a 10-year period

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Fungicides					
Chlorothalonil: Bravo® 500 (40.4% a.i. as a liquid concentrate) *Target pests: Swiss needlecast, Rhabdocline needlecast, Botrytis seedling blight, Phoma twig blight, Sirococcus tip blight*					
High-pressure hydraulic sprayer	Individual trees in any orchard	2.1 lb a.i./acre, in water at 100 gal/acre 1 application to 250 trees	4.2 lb a.i./acre, in water at 100 gal/acre 2 applications to 500 trees	Feb - Jun	1 to 2 times in a 10-year period
Chlorothalonil: Daconil Ultrex® (82.5% a.i. as water-dispersible granules) *Target pests: Alternaria, Anthracnose, Botrytis, Cercospora, and Fusarium leaf spots; and Scirrhia brown spot*					
Chemigation -or- Hand sprayer	Greenhouses 1 and 2 and center-span	1.65 lb a.i./quadrant, in water at 100 gal/quadrant (= 400 gal/greenhouse) 17 applications to 1 greenhouse	4.12 lb a.i./quadrant, in water at 100 gal/quadrant (= 400 gal/greenhouse) 17 applications to 1 greenhouse	May - Dec	Every 2 weeks
Hydrogen Dioxide: ZeroTol® (27% a.i. as a liquid concentrate) *Target pests: Algae, Botrytis, Fusarium, Pseudomonas, Pythium, Phytophthora, Rhizoctinia*					
Chemigation	Greenhouses 1 and 2 and center-span	100 fl. oz. product/quadrant, in water at 100 gal/quadrant (= 400 gal/greenhouse) 47 applications to both greenhouses and center-span	250 fl. oz. product/quadrant, in water at 100 gal/quadrant (= 400 gal/greenhouse) 47 applications to both greenhouses and center-span	Mar 15 and Jul - Jan 15	Every week

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Mancozeb: Dithane T/O (75% a.i. as a microgranular product) *Target pests: Anthracnose, Cylindrosporium, Cercospora and Phomopsis blight, Lophodermium needlecast, pine gall rust, Scirrhia brown spot, cedar-apple rust, Alternaria, and Phyllosticta leaf spots*					
Chemigation -or- Hand sprayer	Greenhouses 1 and 2 and center-span	1.12 lb a.i./quadrant, in water at 100 gal/quadrant (= 400 gal/greenhouse) 14 applications to 1 greenhouse	1.12 lb a.i./quadrant, in water at 100 gal/quadrant (= 400 gal/greenhouse) 14 applications to 1 greenhouse	May - Nov	Every 1 to 2 years as an alternate or supplement to non-chemical treatments
Propiconazole: Banner® MAXX (14.3% a.i. as a liquid concentrate) *Target pests: mildew, rust*					
Tractor-pulled spray rig with boom -or- Hydraulic sprayer with hand-held wand	Native plant beds	0.12 lb a.i./acre, in water at 100 gal/acre 4 applications to 3 acres	0.20 lb a.i./acre, in water at 100 gal/acre 4 applications to 15 acres	Mar - Nov	1 to 2 times per year
Thiophanate-Methyl: Cleary's 3336® WP (50% a.i. as a wettable powder in 8-oz. water soluble bags) *Target pests: Botrytis and Fusarium stem rots*					
Chemigation -or- Hand sprayer	Greenhouses 1 and 2 and center-span	0.38 lb a.i./quadrant, in water at 100 gal/quadrant (= 400 gal/greenhouse) 17 applications to 1 greenhouse	0.75 lb a.i./quadrant, in water at 100 gal/quadrant (= 400 gal/greenhouse) 17 applications to 1 greenhouse	Jun 15 - Jan 15	Every 2 -3 weeks

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Herbicides					
Dicamba: Banvel® (48.2% a.i. as a water-soluble liquid) *Target vegetation: broadleaf weeds*			**Note**: The risk assessment evaluated aerial application of dicamba to fallow fields. Aerial dicamba application is no longer under consideration by BLM, and is not part of any alternative in the IPM program.		
Tractor-pulled spray rig with boom -or- Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Spot treating weeds in fallow areas and any orchard	1 lb a.i./acre, in water at 10 to 100 gal/acre 1 application to 91.5 acres	2 lb a.i./acre, in water at 10 to 100 gal/acre 1 application to 91.5 acres	May - Sep	Back up or alternate to glyphosate or for persistent weeds
Glyphosate: Roundup® (41.0 % a.i. as isopropylamine salt; water-soluble liquid) *Target vegetation: unwanted vegetation*					
Tractor-pulled spray rig with boom -or- Hydraulic sprayer with hand-held wand -or- Backpack sprayer	36 ft^2 around each tree or spot treatment in young orchards and around edges of native plant beds	3 lb a.i./acre of treated area (in water at 10 to 40 gal/acre) = 0.19 lb a.i./orchard acre 1 application to 25 acres	4 lb a.i./acre of treated area (in water at 10 to 40 gal/acre) = 0.25 lb a.i./orchard acre 2 applications to 25 acres	Apr - Jul	Initially 2 to 3 times per year. As plant populations diminish, 1 to 2 times per year to treat new invasions

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Glyphosate: Roundup® (41.0 % a.i. as isopropylamine salt; water-soluble liquid) (continued) *Target vegetation: unwanted vegetation*					
Tractor-pulled spray rig with boom	5-ft strips on each side of tree rows in breeding and preservation orchards	3 lb a.i./acre of treated area (in water at 10 to 40 gal/acre) = 1.1 lb a.i./orchard acre 1 application to 16 acres	4 lb a.i./acre of treated area (in water at 10 to 40 gal/acre) = 1.4 lb a.i./orchard acre 2 applications to 16 acres	Apr - Jul	Initially 2 to 3 times per year. As plant populations diminish, 1 to 2 times per year to treat new invasions.
Tractor-pulled spray rig with boom	Gravel orchard roads	3 lb a.i./acre, in water at 10 to 40 gal/acre 1 application to 8.5 acres	4 lb a.i./acre, in water at 10 to 40 gal/acre 2 applications to 8.5 acres	Apr - Jul	
Backpack sprayer	Spot treatments in orchards and around buildings	3 lb a.i./acre, in water at 10 to 40 gal/acre 1 application to 3 acres	4 lb a.i./acre, in water at 10 to 40 gal/acre 2 applications to 6 acres	Mar - Oct	
Glyphosate: Rodeo® (53.8% a.i. as isopropylamine salt; water-soluble liquid) *Target vegetation: Japanese knotweed, purple loosestrife, bindweed, knapweed, other invasive species*					
Backpack sprayer	Spot treatments in orchards, around buildings, in buffers, and in tiled or riparian areas	3 lb a.i./acre, in water at 10 to 40 gal/acre 1 application to 3 acres	4 lb a.i./acre, in water at 10 to 40 gal/acre 2 applications to 6 acres	Mar - Oct	Initially 2 to 3 times per year. As plant populations diminish, 1 to 2 times per year to treat new invasions.
Hand-held wick	Spot treatments in buffers, and in tiled or riparian areas	17.9 % a.i. solution wiped on individual weed plants 2 applications to weeds on 1 acre	17.9 % a.i. solution wiped on individual weed plants 2 applications to weeds on 2 acres	Mar - Oct	Initially 2 to 3 times per year. As plant populations diminish, 1 to 2 times per year to treat new invasions.

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Glyphosate: Rodeo® (53.8% a.i. as isopropylamine salt; water-soluble liquid) (continued) *Target vegetation: Japanese knotweed, purple loosestrife, bindweed, knapweed, other invasive species*					
Injection (not a method currently allowed by the label; would only be used if this method is added to the label)	Spot treatments in buffers, and in tiled or riparian areas	53.8% a.i. injected into individual plant stems 1 application to weeds on 0.5 acre	53.8% a.i. injected into individual plant stems 1 application to weeds on 1 acre	Mar - Oct	Once per year to treat new invasions
Hexazinone: Velpar® (90% a.i. as a soluble powder) *Target vegetation: unwanted vegetation*					
Tractor-pulled spray rig with boom (roads) -or- Backpack sprayer (fencelines)	Fencelines and roads	1.8 lb a.i./acre, in water at 25+ gal/acre 1 application to 10.5 acres	7.2 lb a.i./acre, in water at 25+ gal/acre 1 application to 10.5 acres	Mar – Oct	Initially 2 to 2 times per year. As plant populations diminish, 1 to 2 times per year to treat new invasions.
Tractor-pulled spray rig with boom -or- Hydraulic sprayer with hand-held wand -or- Backpack sprayer	36 ft^2 around each tree in seed production orchards and around edges of native plant beds	1.8 lb a.i./acre of treated area (in water at 25+ gal/acre) = 0.11 lb a.i./orchard acre 1 application to 10 acres	2.7 lb a.i./acre of treated area (in water at 25+ gal/acre) = 0.17 lb a.i./orchard acre 1 application to 10 acres	Mar – Oct	Used only as an alternate to other herbicides such as glyphosate, 1 to 2 times in a 10-year period

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Hexazinone: Velpar® (90% a.i. as a soluble powder) (continued) *Target vegetation: unwanted vegetation*					
Tractor-pulled spray rig with boom	5-ft strips on each side of tree rows in breeding and preservation orchards and around edges of native plant beds	1.8 lb a.i./acre of treated area (in water at 25+ gal/acre) = 0.65 lb a.i./orchard acre 1 application to 5 acres	2.7 lb a.i./acre of treated area (in water at 25+ gal/acre) = 0.97 lb a.i./orchard acre 1 application to 5 acres	Mar- Oct	Used only as an alternate to other herbicides such as glyphosate, 1 to 2 times in a 10-year period
Picloram: Tordon® 22K (24.4% a.i. as a liquid concentrate) *Target vegetation: scotchbroom, bindweed, other noxious weeds*					
Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Spot treat noxious weeds in all orchards	0.25 lb a.i./acre, in water at 10 to 50 gal/acre 1 application to 2 acres	1 lb a.i./acre, in water at 10 to 50 gal/acre 2 applications (in two separate locations) to 2 acres per application	May - Aug	Primarily as an alternate to other chemicals for noxious weed control, especially spot treatments of persistent noxious weeds or other vegetation. 1 to 2 times in a 10-year period

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency
Triclopyr: Garlon® 3A (44.4% a.i. as a liquid concentrate) *Target vegetation: bindweed, tansy ragwort, poison oak, thistle*					
Backpack sprayer	Fencelines, stump treatment in any orchard	1.5 lb a.i./acre, in water at 10 to 100 gal/acre -or- Undiluted for stump treatment 1 application to 2 acres	9 lb a.i./acre, in water at 10 to 100 gal/acre -or- Undiluted for stump treatment 1 application to 2 acres	May - Aug	Primarily as an alternate to other chemicals for noxious weed control, especially spot treatments of persistent noxious weeds or other vegetation. 1 to 2 times in a 10-year period
Triclopyr: Garlon® 4 (61.6% as a liquid concentrate) *Target vegetation: bindweed, tansy ragwort, poison oak, thistle*					
Backpack sprayer	Fencelines, basal bark treatment in any orchard	1.5 lb a.i./acre, in water at 10 to 100 gal/acre -or- As a 0.04 to 0.2 lb a.i./gal mixture in oil for basal bark treatment 1 application to 2 acres	8 lb a.i./acre, in water at 10 to 100 gal/acre -or- As a 0.04 to 0.2 lb a.i./gal mixture in oil for basal bark treatment 1 application to 2 acres	May - Aug	Annually or less
Fumigant					
Dazomet: Basamid® Granular (99% as a granular material) *Target pests: nematodes, weeds, fungi*					
Ground pull fertilizer-type spreader	Native plant beds	173 lb a.i./acre 1 application to 2 acres	300 lb a.i./acre 1 application to 3 acres	Apr - Jul	Annually or less, depending on the plant species

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Application Rate and Max Area	Application Date Range	Anticipated Frequency
Fertilizers					
Ammonium-phosphate sulfate (16-20-0-15), ammonium nitrate (34-0-0), monoammonium phosphate (11-52-0), sulfate of potash (0-0-50), and Perfection Standard Blends (16-16-16-7, 15-20-8, 20-10-10-10, 18-18-18-2, and 13-39-0-7)		**Note:** The risk assessment listed typical and maximum ammonium phosphate-sulfate application rates of 300 and 600 lb/acre, respectively; and a typical monoammonium phosphate application rate of 95 lb/acre. The following lists include revisions to those numbers, showing the current expected use rates. Urea was evaluated in the risk assessment, but is no longer proposed for use. The risk assessment modeled use of diammonium phosphate and ammonium nitrate, so the results of the analysis are not affected by these revisions. **Note:** Maximum fertilizer application rates are not proposed in Alternative B (proposed action).			
Granular spreader	All orchard units	200 lb/acre ammonium phosphate-sulfate -or- 200 lb/acre ammonium nitrate -or- 100 lb/acre monoammonium phosphate -or- 200 lb/acre sulfate of potash -or- 200 lb/acre Perfection Standard Blend 16-16-16-7 -or- 200 lb/acre Perfection Standard Blend 15-20-8 -or- 200 lb/acre Perfection Standard Blend 20-10-10-11 -or 200 lb/acre Perfection Standard Blend18-18-18-2 -or- 200 lb/acre Perfection Standard Blend 13-39-0-7 -or- 400 lb/acre diammonium phosphate 1 application to 200+ acres on Mar 15	300 lb/acre ammonium phosphate-sulfate -or- 300 lb/acre ammonium nitrate -or- 200 lb/acre monoammonium phosphate -or- 300 lb/acre sulfate of potash -or- 300 lb/acre Perfection Standard Blend 16-16-16-7 -or- 300 lb/acre Perfection Standard Blend 15-20-8 -or- 300 lb/acre Perfection Standard Blend 20-10-10-11 -or- 400 lb/acre Perfection Standard Blend 18-18-18-2 -or- 300 lb/acre Perfection Standard Blend 13-39-0-7 -or- 800 lb/acre diammonium phosphate 1 application to 200+ acres on Mar 15	Feb - Apr	Annually or less

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Application Rate and Max Area	Application Date Range	Anticipated Frequency
Calcium nitrate: 15.5-0-0					
Granular spreader	All orchard units	9.30 - 41.03 lb/tree, equivalent to 200 lb N/acre 1 application to 65 acres on Apr 30	9.30 - 41.03 lb/tree, equivalent to 200 lb N/acre 1 application to 95 acres on Apr 30	Mar - May	Annually or less

[a] The formulations listed are those currently expected to be used. If other formulations of the same active ingredient are used, the application methods, locations, area, date range, frequency, and active ingredient application rates listed in this table would still apply.

Table 2.6-1. Summary of Potential Impacts by Alternative

Resource	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Air Quality	NS*	NS	NS	NS	NS
Geological Resources	NS	NS	NS	NS	NS
Water Resources	**Groundwater:** No significant impacts: Although some of the proposed insecticides, herbicides, and fertilizers could leach, the predicted concentrations were far below levels of concern for human health and ecological protection.	**Groundwater:** No significant impacts: Although some of the proposed insecticides, herbicides, and fertilizers could leach, the predicted concentrations were far below levels of concern for human health and ecological protection.	**Groundwater:** No significant impacts: Although some of the proposed insecticides, herbicides, and fertilizers could leach, the predicted concentrations were far below levels of concern for human health and ecological protection.	**Groundwater:** No significant impacts: Although some of the proposed fertilizers could leach, the predicted concentrations were far below levels of concern for human health and ecological protection.	**Groundwater:** Pesticide and fertilizer chemicals could leach to groundwater, depending on project-specific details, limitations, and mitigations. Impacts would be identified in project-specific EAs.
	Streams and Rivers: Runoff or drift from pesticide or fertilizer applications could enter surface water. (The effects of the estimated stream concentrations on human health and aquatic species are described under those headings.)	**Streams and Rivers:** No significant impacts to surface water, since limitations would be implemented that control runoff and drift potential. (The effects of estimated stream concentrations on health and aquatic species are described under those headings.)	**Streams and Rivers:** No significant impacts to surface water, since limitations would be implemented that control runoff and drift potential. (The effects of estimated stream concentrations on health and aquatic species are described under those headings.)	**Streams and Rivers:** Runoff from fertilizer applications could enter surface water. (The effects of estimated stream concentrations on health and aquatic species are described under those headings.)	**Streams and Rivers:** Runoff or drift from pesticide or fertilizer applications could enter surface water, depending on project-specific details. Impacts from pesticides would be identified in project-specific EAs.
	Accidents: Spill of pesticide concentrate or mix could contaminate surface water or groundwater.	**Accidents:** Spill of pesticide concentrate or mix could contaminate surface water or groundwater. Pesticide transport over specific streams would be prohibited, decreasing probability of an accidental spill to surface water.	**Accidents:** Spill of pesticide concentrate or mix could contaminate surface water or groundwater. Pesticide transport over specific streams would be prohibited, decreasing probability of an accidental spill to surface water.	**Accidents:** NS	**Accidents:** Spill of pesticide concentrate or mix could contaminate surface water or groundwater.
Land Use	NS	NS	NS	NS	NS

Table 2.6-1. Summary of Potential Impacts by Alternative (continued)

Resource	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Human Health and Safety	**Members of the Public:** No significant impact from use of any proposed control method. An accidental pesticide spill into a stream would make it unsafe for drinking or fishing.	**Members of the Public:** No significant impact from use of any proposed control method. An accidental pesticide spill into a stream would make it unsafe for drinking or fishing. Pesticide transport over specific streams would be prohibited, decreasing probability of an accidental spill to surface water.	**Members of the Public:** No significant impact from use of any proposed control method. An accidental pesticide spill into a stream would make it unsafe for drinking or fishing. Pesticide transport over specific streams would be prohibited, decreasing probability of an accidental spill to surface water.	**Members of the Public:** NS	**Members of the Public:** No significant impact from use of any proposed control method, if used as described under any action alternative. Unknown risks if pesticides other than those included in this EIS are used. An accidental pesticide spill into a stream would make it unsafe for drinking or fishing.
	Workers: Adverse health effects possible from some pesticide applications. Health risks predicted for accidental spill onto skin of pesticide concentrates or dilutions. Possible injuries from cultural or prescribed fire methods.	**Workers:** No significant impact predicted from pesticide applications. Health risks predicted for accidental spill onto skin of pesticide concentrates or dilutions. Possible injuries from cultural or prescribed fire methods.	**Workers:** No significant impact predicted from pesticide applications. Health risks predicted for accidental spill onto skin of pesticide concentrates or dilutions. Possible injuries from cultural or prescribed fire methods.	**Workers:** Possible injuries from cultural or prescribed fire methods.	**Workers:** Adverse health effects possible from some pesticide applications. Health risks predicted for accidental spill onto skin of pesticide concentrates or dilutions. Possible injuries from cultural or prescribed fire methods.

Table 2.6-1. Summary of Potential Impacts by Alternative (continued)

Resource	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Biological Resources	**Non-Target Vegetation:** NS	**Non-Target Vegetation:** NS	**Non-Target Vegetation:** NS	**Non-Target Vegetation:** NS	**Non-Target Vegetation:** NS
	Terrestrial Wildlife: Possible risks to birds, amphibians, and special status species under typical and maximum conditions (and mammals under maximum conditions only) from three proposed insecticides and calcium nitrate fertilizer. Many non-target insects in an area treated with insecticide would be killed. No significant impacts from biological, cultural, prescribed fire methods.	**Terrestrial Wildlife:** Many non-target insects in an area treated with insecticide would be killed. No significant impacts from biological, cultural, prescribed fire, or other methods.	**Terrestrial Wildlife:** Many non-target insects in an area treated with insecticide would be killed. No significant impacts from biological, cultural, prescribed fire, or other methods.	**Terrestrial Wildlife:** Possible risks to special status species from calcium nitrate fertilizer.	**Terrestrial Wildlife:** Risks to non-target wildlife possible, depending on project-specific details, limitations, and mitigations. Possible risks to special status species from calcium nitrate fertilizer. Many non-target insects in an area treated with insecticide would be killed. No significant impacts from biological, cultural, prescribed fire methods.
	Aquatic Species: No significant risks from chemical, biological, prescribed fire, or cultural control methods. Potential sublethal effects from fertilizers to special status aquatic species in maximum scenario only. An accidental pesticide spill into a stream would have adverse effects on aquatic species.	**Aquatic Species:** No significant risks from use of any proposed control methods. An accidental pesticide spill into a stream would have adverse effects on aquatic species. Pesticide transport over specific streams would be prohibited, decreasing probability of an accidental spill to surface water.	**Aquatic Species:** No significant risks from use of any proposed control methods. An accidental pesticide spill into a stream would have adverse effects on aquatic species. Pesticide transport over specific streams would be prohibited, decreasing probability of an accidental spill to surface water.	**Aquatic Species:** No significant risks from biological, prescribed fire, or cultural control methods. Potential sublethal effects from fertilizers to special status aquatic species in maximum scenario only.	**Aquatic Species:** No significant risks from chemical, biological, prescribed fire, or cultural control methods, if used as described under any action alternative. Potential sublethal effects from fertilizers to special status aquatic species in maximum scenario only. An accidental pesticide spill into a stream would have adverse effects on aquatic species.

Table 2.6-1. Summary of Potential Impacts by Alternative (continued)

Resource	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Noise	NS	NS	NS	NS	NS
Cultural Resources	NS	NS	NS	NS	NS
Socioeconomics and Environmental Justice	NS	NS	NS	NS	NS

*NS = no significant impacts predicted; see Chapter 4 for details.

3.0 Affected Environment

3.1 Introduction

This chapter describes the relevant environment at Horning, providing baseline information to allow the evaluation of potential environmental impacts that could result from the proposed action or an alternative action. As stated in 40 CFR 1508.14, the human environment includes natural and physical resources and the relationship of people to those resources. The environmental baseline resources described in this chapter were selected after identifying the potential issues and concerns related to the proposed action and alternatives. The relevant resources are described in a sufficient level of detail to adequately support the impact analysis. Those resources which are potentially affected most significantly, such as human health and biological resources, are described in greatest detail. Those resources which are likely to be impacted least, such as cultural resources and noise, are described in lesser detail.

The following resources would not be affected and are therefore not described in this chapter, nor evaluated in Chapter 4, in accordance with 40 CFR 1502.15:

- Visual resources: No structures would be built or demolished, nor would there be any activities that would affect visual or aesthetic resources as a result of the proposed action or an alternative. The closest wilderness area to the orchard is BLM's Table Rock Wilderness, located about 15 miles south of the orchard. In addition, the Mount (Mt.) Hood Wilderness Area (a Class I area), is located about 30 miles to the east.
- Transportation: No construction vehicles would be involved with any action, nor would there be any changes to vehicular traffic near Horning.

The chapter begins with a discussion of the resources that may be affected by the proposed action or an alternative. The order of resource description is based on introducing the physical environment (air, geology, and water), followed by land use, human health, biological resources, and the human environment (noise, cultural resources, socioeconomics, and environmental justice).

3.2 Air Resources

This section discusses the climate, meteorology, and regional air quality of the area around Horning.

3.2.1 Climate and Meteorology

Horning is approximately 23 miles southeast of the city of Portland, situated in rolling hills west of Mt. Hood National Forest. The town of Estacada is about eight miles northeast of the orchard. Elevation at Horning ranges from 900 to 1,140 feet above sea level. Its geographical location between the Pacific Ocean and Cascade Mountains results in a maritime west coast climate, featuring mild, wet winters and cool, dry summers. The average July temperature at Estacada is 66° F, the average January temperature is 40° F, and average annual precipitation is 59 inches. Most of the precipitation occurs between the months of October and March, consistent with the frequent Pacific storm patterns (see Table 3.2-1). Precipitation during the spring and summer months is typically very light. Annual average relative humidity ranges from a high of about 86%, typically in early morning, to a low of 59%, typically in the early afternoon. As recorded at the Portland Airport, winds are predominantly from the northwest throughout the months of April

Table 3.2-1. Climate Characteristics[a]

Characteristic	Month												Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean temperature (° F)	39.7	42.7	46.5	50.7	55.9	60.8	65.9	66.0	61.4	52.6	44.9	39.8	52.2
Mean precipitation (in)	8.04	6.95	6.18	5.08	4.04	2.68	1.07	1.28	2.47	4.77	8.45	8.47	59.48
Average days with 0.5 or more inches of rain	6.0	4.8	4.2	3.2	2.5	1.4	0.5	0.8	1.8	3.2	6.2	5.9	40.4

[a]Data are for Estacada for the period of record 1971 - 2000 (Oregon Climate Service 2002a).

through September and from the east and southeast from October through March. Table 3.2-2 presents wind speed data from the Portland Airport, 29 miles to the north; average wind speeds usually range from 7 to 10 miles per hour year round.

3.2.2 Regional Air Quality

The National Ambient Air Quality Standards (NAAQS), established by EPA and adopted by ODEQ, define the maximum allowable concentrations of pollutants that may be reached but not exceeded within a given time period. Primary standards protect public health, and secondary standards protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Section 110 of the *Clean Air Act* requires states to develop air pollution regulations and control strategies to ensure that state air quality meets the NAAQS established by EPA. These ambient standards, established under Section 109 of the *Clean Air Act*, currently address six criteria pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), lead (Pb), particulate matter (PM), and sulfur dioxide (SO_2). Particulate matter is further regulated by size for particles smaller than 10 microns in diameter (PM_{10}). Exceeding the NAAQS concentration is referred to as "nonattainment" of the pollutant standard.

Table 3.2-3 presents the current NAAQS and the Oregon Ambient Air Quality Standards for the six criteria pollutants, along with regional air quality data for 2001, during which time all standards were met.

The *Clean Air Act* Amendments of 1970 established three Federal air quality control regions (AQCRs) in western Oregon. Horning is located in the Portland Interstate

Table 3.2-2. Wind Characteristics[a]

Characteristic	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Prevailing direction[b]	ESE	ESE	ESE	NW	NW	NW	NW	NW	NW	ESE	ESE	ESE
Average wind speed (mph)[c]	8.7	7.5	7.1	5.8	5.4	5.4	6.1	5.6	4.9	5.4	6.8	8.6
Percent occurrence of wind speeds for all directions:												
Calm	6.8	12.3	10.8	10.8	10.4	10.3	7.2	9.5	12.5	15.3	13.5	8.9
1-3 mph	17.0	20.6	23.0	28.9	28.3	26.6	21.5	23.9	31.9	29.1	24.0	17.3
4-7 mph	22.4	22.4	24.6	29.9	34.3	35.5	37.3	37.7	33.9	28.7	23.8	22.7
8-12 mph	26.8	22.9	23.7	21.2	21.3	23.2	29.1	25.5	17.4	18.0	20.4	22.6
> 12 mph	27.0	21.8	17.9	9.1	5.6	4.4	5.0	3.4	4.2	8.9	18.3	28.5

[a]Data are for the Portland Airport for the period of record 1949 - 1958 (Oregon Climate Service 2002b).
[b]Highest total percentage per direction observed during month.
[c]Averaged for all directions observed per month.

Table 3.2-3. National and State Ambient Air Quality Standards and Data[a]

Pollutant	Averaging Time	Standard[b]			2001 Air Quality Data (ppm)[d]
		Primary NAAQS	Secondary NAAQS	Oregon AAQS	
O_3	1 hr 8 hr[c]	0.12 ppm (235 μg/m^3) 0.08 ppm (157 μg/m^3)[c]	—	0.12 ppm —	0.069 0.099
CO	1 hr 8 hr	35 ppm (40 mg/m^3) 9 ppm (10 mg/m^3)	—	35 ppm 9 ppm	7.5 6.0
NO_2	Annual arithmetic mean	0.053 ppm (100 μg/m^3)	Same as primary NAAQS	0.053 ppm	0.052[e]
SO_2	3 hr 24 hr Annual arithmetic mean	0.50 ppm (1,300 μg/m^3) 0.14 ppm (365 μg/m^3) —	— — 0.03 ppm (80 μg/m^3)	0.50 ppm 0.10 ppm 0.02 ppm	ND[f] ND ND
PM_{10}	Annual arithmetic mean 24 hours	50 μg/m^3 150 μg/m^3	Same as primary NAAQS	50 μg/m^3 150 μg/m^3	19.8 45
$PM_{2.5}$[c]	Annual arithmetic mean[c] 24 hours[c]	15 μg/m^3 [c] 65 μg/m^3 [c]	Same as primary NAAQS	—	8.9 50
Pb	Quarterly	1.5 μg/m^3	Same as primary NAAQS	1.5 μg/m^3	0.02

[a]40 CFR 50, OAR 340-202, ODEQ 2002a.
[b]mg/m3 — milligrams per cubic meter; μg/m3 — micrograms per cubic meter; ppm — parts per million.
[c]A 1999 Federal court ruling has blocked implementation of these standards; they are included for information purposes only at this time.
[d]Maximum reading from 2001 in the Portland and Salem areas.
[e]1-hour average; annual arithmetic mean not available.
[f]ND = no data available.

AQCR. Air quality throughout this area currently meets Federal standards. However, a portion of the Portland urban area (the Portland Air Quality Maintenance Area) has been under a maintenance plan for ozone since June 1997 because, for a time prior to that, the area was in nonattainment of the NAAQS for ozone. Horning is about six miles east and ten miles south of this maintenance area. The Portland Metro Service District Boundary has been in maintenance for CO since October 1997. Horning is about 12 miles outside of this area. The seed orchard and its vicinity are in attainment for all criteria pollutants; that is, the national primary and secondary standards are met.

3.3 Geological Resources

3.3.1 Physiography and Topography

Horning is located within the Willamette Valley near the Cascade Mountains in an area of rolling hills with slopes from 2 to 36 percent. Elevations at Horning range from about 900 to 1,140 feet. Slopes are generally to the west and southwest in Section 23 and to the

east and northeast in Section 13. Tributaries to Nate Creek in Section 23 and to Swagger Creek in Section 13 have cut moderately to steeply sloped valleys into the local hills.

3.3.2 Geology

Horning is located within an area known as the Eola Surface, the oldest erosional surface in the Willamette Valley. This surface is gently inclined between the Cascade Mountains and the Willamette Valley, and is covered with material which has been eroded (known as colluvium), and continues to erode, from the mountains. The colluvium ranges in size from fine material (clays and silts) to coarser materials such as sand, gravel, and boulders. Much of the eroded material has been in place for a long period of time and is highly weathered, containing a high proportion of clay. The colluvium is about 100 feet thick, overlying thin lava flows and volcanic bedrock. Silt and clay are interbedded with the sand and gravel and there are areas with boulders at or near the surface. The colluvium is derived from volcanic material, primarily basalt and andesite, which has eroded from the Cascade Mountains. An area of sandstone underlies a small part of the seed orchard. The sandstone underlying the site and surrounding areas is very permeable and contains shallow aquifers. The water table is typically about 10 feet below the surface and well depths in the area range from 25 to 700 feet (USGS 1994).

3.3.3 Soils

Soil is formed by physical and chemical processes that are determined by parent material (from which the soils are derived), climate, living organisms (plants, animals, and microorganisms), topography, and time. Cool, dry summers and cool, moist winters at Horning result in a mixture of deciduous and conifer trees, shrubs, and grasses. A relatively high amount of organic material is returned to the soil each year from leaves and the annual dieback of vegetation. The topographic position of these soils has resulted in well-drained soils. These soils have been weathered for a long period of time, producing a high clay content and relative low amount of some minerals.

Four types of soil are present at Horning: Cottrell silty clay loam, Jory silty clay loam, Klickitat stony loam, and Springwater loam (SCS 1985). The cation exchange capacity of each of these soils (except for the Klickitat series, for which it is undetermined) is in the range of 10 to 25 milliequivalents per 100 grams, indicating that they contain smectite clay and a moderate amount of organic matter, which adsorbs pesticides and fertilizers and retards their movement through the soil. The following paragraphs describe the soils identified on the seed orchard. Table 3.3-1 presents soil characteristics relevant to the environmental mobility of fertilizers and pesticides.

Cottrell silty clay loam is a deep, moderately well-drained soil on high terraces and rolling uplands and formed in silty material and colluvium derived mainly from basalt. At Horning, this soil occurs in and along streambeds. This soil is highly weathered. Typically, the surface layer is very dark grayish brown and dark brown silty clay loam about 12 inches thick. The upper 12 inches of the subsurface is dark brown silty clay loam, and the lower 31 inches is mottled dark brown silty clay. The substrate to a depth of 60 inches is reddish brown silty clay loam. The available water holding capacity is 0.15 to 0.21 inches of water per inch of soil. The rooting depth is 40 to 60 inches. Runoff is slow, and hazard of erosion by water is slight. The hazard of erosion by wind is very slight. The main limitation for tree growth is a moderate to high susceptibility for compaction due to wetness. Soil pH is from 5.1 to 6.0. These soils occur in creeks and drainage ways and are not managed areas at the seed orchard.

Table 3.3-1. Soils at the Horning Seed Orchard

Soil Series	Depth (in.)	Permeability (in/hr)	Depth to Water Table (ft)	Runoff	Slope (%)	Organic Matter (%)	Clay (%)	Soil Sensitivity[1]
Cottrell	0 - 24	0.6 - 2.0	2 - 3 (winter), > 6 (summer)	slow	2 - 8	3 - 4	27 - 35	very low
	24 - 55	0.2 - 0.6				0.5 - 3	40 -50	
	55 - 86	0.2 - 0.6				0 - 0.5	30 - 45	
Jory	0 - 13	0.6 - 2.0	> 6	slow to rapid	2 - 30	3 - 6	27 - 40	very low
	13 - 60	0.2 -0.6				0.5 - 2	45 - 60	
Klickitat	0 - 15	0.6 - 2.0	> 6	rapid	30 - 60	3 - 6	20 - 27	low
	15 - 35	0.6 - 2.0				0.5 - 3	27 - 33	
	35 - 48	0.6 - 2.0				0 - 0.5	20 - 27	
	48 - 52	---				---	---	
Springwater	0 - 7	2.0 - 6.0	> 6	medium	8 - 15	4 - 6	20 - 27	low
	7 - 37	0.6 - 2.0				0.5 - 4	27 -35	
	37 - 47	---				---	---	

Sources: SCS 1985, OSUES 1998.
[1]The Oregon State University Extension Service developed soil sensitivity ratings for groundwater contamination based on leaching characteristics (permeability, soil depth, depth to groundwater, annual precipitation, and runoff as compared to infiltration) and sorption potential (the amount of organic matter and the cation exchange capacity) (OSUES 1998).

Jory silty clay loam is a deep, well-drained soil on the hill slopes throughout the seed orchard, including nearly all the managed lands. It formed in colluvium derived mainly from basalt, and is highly weathered. Typically, the surface layer is a dark brown silty clay loam about seven inches thick. The upper six inches of the subsoil is dark reddish brown silty clay loam, the next 30 inches is dark red and yellowish red silty clay, and the substrate down to 60 inches is dark reddish brown and dark red silty clay. The available water holding capacity is 0.15 to 0.21 inches of water per inch of soil. This soil is droughty in the summer. The potential rooting depth is 60 or more inches, with an effective rooting depth of about 24 inches. Runoff ranges from slow to rapid, increasing with slope. The hazard of erosion by water also depends on slope, ranging from slight to severe. The hazard of erosion by wind is very slight. The main limitation for tree growth is a high susceptibility for compaction, especially when the soil is wet. A tillage pan (a layer of compacted soil) forms easily if the soil is tilled when wet. Soil pH is from 4.5 to 6.5. The majority of seed production areas occur in this soil, particularly where the slope is less than 8%. The amount of coarse material in the soils (including large boulders) increases with increasing slope. Areas with a slope of 15% or more are not developed as orchard tree units.

Klickitat stony loam occurs in a small area along the eastern border of the portion of the orchard located in Section 13. These soils are located in mountainous uplands in areas of 30 to 60% slope. At Horning, they are located in the valley of an unnamed stream draining into the Swagger Creek. They were formed in colluvium derived from basalt and andesite. These soils are moderately weathered. The topsoil is dark brown to dark reddish brown stony loam about 15 inches in depth. The subsoil is dark reddish brown very gravelly clay loam grading to very cobbly clay loam. From 35 to 48 inches in depth, the soil is reddish brown extremely cobbly loam. Fractured basalt typically

occurs at a depth of 48 inches. The available water holding capacity is 0.08 to 0.10 inches of water per inch of soil. The rooting depth is 40 to 60 inches. Runoff is rapid, and hazard of water erosion is severe. The hazard of wind erosion is very slight. The main limitation for tree growth is the stone content of the soil, the steepness of the slope, and the instability of the soil. Soil pH is from 4.5 to 6.0. The acreage of this soil at Horning is minor, and forms a stream buffer supporting mixed vegetation.

Springwater loam occurs in a small area along the eastern border of the portion of the seed orchard located in Section 13. These soils are located in rolling uplands in areas of 8 to 15% slope. They were formed in colluvium derived from sandstone. They are moderately weathered. The topsoil is dark brown loam and clay loam about 15 inches in depth. The subsoil is brown clay loam to gravelly clay loam. Fractured sandstone typically occurs at a depth of 37 inches (the depth varies from about 20 to 40 inches). The available water holding capacity is 0.14 to 0.21 inches of water per inch of soil. The rooting depth is restricted by the depth of the sandstone. Runoff is medium, and hazard of erosion by water is moderate. These soils are not subject to wind erosion. The main limitation for tree growth is the restricted rooting depth due to the sandstone. Soil pH is from 5.6 to 6.0. The acreage of this soil at Horning is minor and is found in the orchard units.

3.4 Water Resources

Water is a key resource because it is influenced by, and in turn influences, activities and resources outside the seed orchard. Water also provides habitat for fish and aquatic animals, as well as plants and animals that use streamside and pondside areas. Water entering the seed orchard can be a source of pollutants, bringing in organisms that cause tree diseases or bringing in pesticide residues from other agricultural operations. There is also the potential for water to take pollutants out of the seed orchard.

Horning is located on the watershed divide between the Clackamas River and Molalla River in the Willamette River basin, north of Colton. The orchard is divided into two primary areas, in Sections 13 and 23, both located within Township 4 South and Range 3 East.

The Willamette Basin is the subject of several studies conducted by the Oregon Water Resources Department (OWRD) and the U.S. Geological Survey (USGS) (OWRD 2000, USGS 1998, USGS 2000). In addition, ODEQ began investigating the status of the health of the Willamette River Basin in the early 1990s. The results of five years of water quality studies, many of which were conducted in cooperation with USGS, are available to the public at ODEQ websites http://www.deq.state.or.us/wq/Willamet/tetrareports.htm and http:/www.deq.state.or.us/wq/Willamet/Will_hom.htm.

3.4.1 Groundwater

There is no site-specific information on groundwater for Horning with respect to flow direction or quality. However, the seed orchard does not cross any EPA- or state-designated sole-source aquifers, wellhead protection areas, or groundwater management areas.

Although not site-specific to Horning, information is available for the Willamette Basin. One example is a joint study conducted by the USGS and OWRD in the mid 1990s on groundwater resources of the Willamette Basin. The Oregon USGS website (http://oregon.usgs.gov/projs_dir/willgw/) contains a complete description of the study, including a project overview and summary, as well as links to resulting publications (OWRD 2000).

A variety of rock types underlie the Willamette Basin, ranging from predominantly marine sedimentary rock in the western portion (Coast Range) to a variety of lava flows and volcanic sediments in the eastern part (Cascade Range). The Willamette Valley, which lies between the two ranges, includes a substantial thickness of basalt lava that flowed into the region during the early stages of basin development. The basalt lava has been folded and faulted, and now forms a series of uplands that separate the Willamette Valley into a series of sediment-filled sub-basins. The basalt lava is exposed in the uplands that separate the sub-basins, and lies beneath the valley-filling sediments in the intervening areas. Materials left below the area's rolling topography by these processes have given variable permeability and uneven depth to zones that would act as aquifers. In addition, because of folding and faulting, the basalt is less a single aquifer than it is several small, unconnected aquifers.

Storage of water in the basalt is limited, so it is likely that most water accessed by area wells is from above the basalt. Records from well logs in the area indicate that there are a total of 17 domestic wells over the area of Sections 13 and 23, including one within the grounds at Horning (OWRD 2002a). Based on the well drilling logs (OWRD 2002a), well depths in Sections 13 and 23 range from 82 to 287 feet, with "first water" reached between 53 feet and 155 feet; the average "first water" depth for these wells was approximately 102 feet. Once collected, the static water level in these wells ranged from 10 to 150 feet, with an average static water level of approximately 51 feet.

There are three active wells on the orchard property. The first well was drilled in 1966 in Section 13. The latest well test shows that it produces 52 gallons per minute. "First water" was noted at a depth of 61 feet, with a static level currently at 32 feet below the ground surface. This is a change from 26 feet at the time of drilling. The second well was drilled in 1975 in Section 23 and has a static level of 10 feet. Renovations were made in August 1999, and a change in the static water level, now at 18 feet below land surface (down from 1975 level of 10 feet), was noted. Well yield was 4 gallons per minute. It is temporarily out of use and will probably be reactivated in 2003. There is another active well in Section 23 that was drilled in the early 1970s by the previous landowner. That well was 60 feet in depth with a static level of 20 feet and produces 2½ gallons per minute. It is currently being used for a drip irrigation system.

In general, groundwater availability in the Willamette Basin varies locally and depends on several factors, including (1) interference with surface water sources withdrawn from further appropriation, (2) seasonal well-to-well interference, (3) long-term water level declines caused by overpumping, (4) low-yield aquifers, and (5) natural groundwater quality problems, such as high salinity and high arsenic concentrations, which limit potability (OWRD 2000).

3.4.2 Surface Water

Horning is located on the watershed divide between the Clackamas River and Molalla River Basins, northeast of Colton. In this position, the orchard serves as the headwaters for a number of small streams within its boundaries. Streams in the Section 13 portion of the orchard flow into Swagger Creek, a tributary to Clear Creek, which in turn flows into the Clackamas River. Streams in the Section 23 portion flow into Nate Creek, a tributary to Milk Creek, or directly into Milk Creek, which in turn flows into the Molalla River.

The closest streamflow gage to the orchard that provides a current indication of the relative timing and amount of flow of a similar watershed in terms of size, precipitation, land use, and vegetation is USGS streamflow gage 14200300 on Silver Creek, approximately 25 miles south of the seed orchard. Data indicate a streamflow pattern consistent with precipitation levels, with the higher flows and precipitation occurring between November and April, and a reduction in storm flows after the month

of May. Historical streamflow records (1936 and 1937 only) show a streamflow for Milk Creek (gage 14199600, near Colton, OR) generally ranging between 0 and 10 cubic feet per second (cfs), with a peak of 22 cfs in July; and a streamflow for Clear Creek (gage 14210650, at Viola, OR) generally ranging from 10 cfs in the summer and fall to between 100 and 200 cfs from February to June (OWRD 2002b).

Since Horning is located on a topographic divide, most of the streams that drain the area have ephemeral and intermittent flow characteristics. Ephemeral streams flow in direct response to storm events while the intermittent streams flow during the late fall, winter, and spring periods of higher precipitation. There is one larger perennial stream that bisects the Section 13 portion of the seed orchard, and several smaller perennial streams. The extent of historic ephemeral channels and their associated wet areas have been reduced in the past through the installation of subsurface drainage ("tiling") to increase the area available for tree production. In Section 23, Stream 8 is ephemeral north of Unger Road, and when it flows, it goes underground before reaching the road. Flow resurfaces near the BLM property line. There is no direct surface connection between Streams 8d and 8e and Milk Creek. Figures 3.4-1 (Section 13) and 3.4-2 (Section 23) illustrate the orchard's water resources, including a number for each stream segment. Table 3.4-1 contains hydrologic and riparian information for these streams.

There is one unnamed perennial reservoir in the western half of Section 13 that provides the orchard with water for irrigation and fire suppression. It has a surface area of approximately one acre and a storage water right of 2.5 acre-feet. A perennial stream channel occurs at both the inlet and outlet.

Downstream beneficial uses of record for streams in and below the Section 13 (Clear Creek drainage) and Section 23 (Milk Creek drainage) portions of Horning are shown in Table 3.4-2. These beneficial uses represent the first use to be encountered downstream of the orchard in each of their categories. A full listing of non-canceled water rights on record in the Oregon Water Resources Department's Water Rights Inventory System (WRIS) is available at the Salem District BLM Office and on the web at http://www.wrd.state.or.us/. Irrigation represents the majority of recorded beneficial uses in the water rights records for the Clear Creek and Milk Creek watersheds.

BLM has monitored the water quality of selected streams within the seed orchard since 2001. Chapter 4 includes a discussion of the ongoing monitoring program and results to date.

Section 305(b) of the Federal *Clean Water Act* requires each state to prepare a water quality assessment report every two years. The most recent assessment for Oregon was prepared in 2000 and includes stream assessment data, information on water quality trends, results of biological and habitat surveys, and the state's water quality protection efforts (ODEQ 2000). In addition, water quality data are routinely collected by the ODEQ laboratory from 159 monitoring sites on major rivers and streams throughout the state. Data collected from the Molalla and Clackamas sub-basins for the period 1986 to 1995 are summarized in the following paragraph (ODEQ undated).

The absence of major point sources and favorable hydrologic conditions enable the Molalla River, within the Middle Willamette Basin, to readily assimilate pollution. The Molalla River at Canby experiences elevated levels of total phosphates, nitrate and ammonia nitrogen, fecal coliform, and biochemical oxygen demand in the fall, winter, and spring. High temperature, high biochemical oxygen demand, and low dissolved oxygen concentrations are evident in the low flow summer months. This is the result of non-point source pollution in the low-lying agricultural areas along the lower half of the river. These impacts appear to have increased over time, as water quality significantly declined during the reporting period. On average, however, the water quality index scores are good throughout the year. Water quality in the Clackamas River is generally

Figure 3.4-1: Water Resources at Horning- Section 13 of T4S, R3E

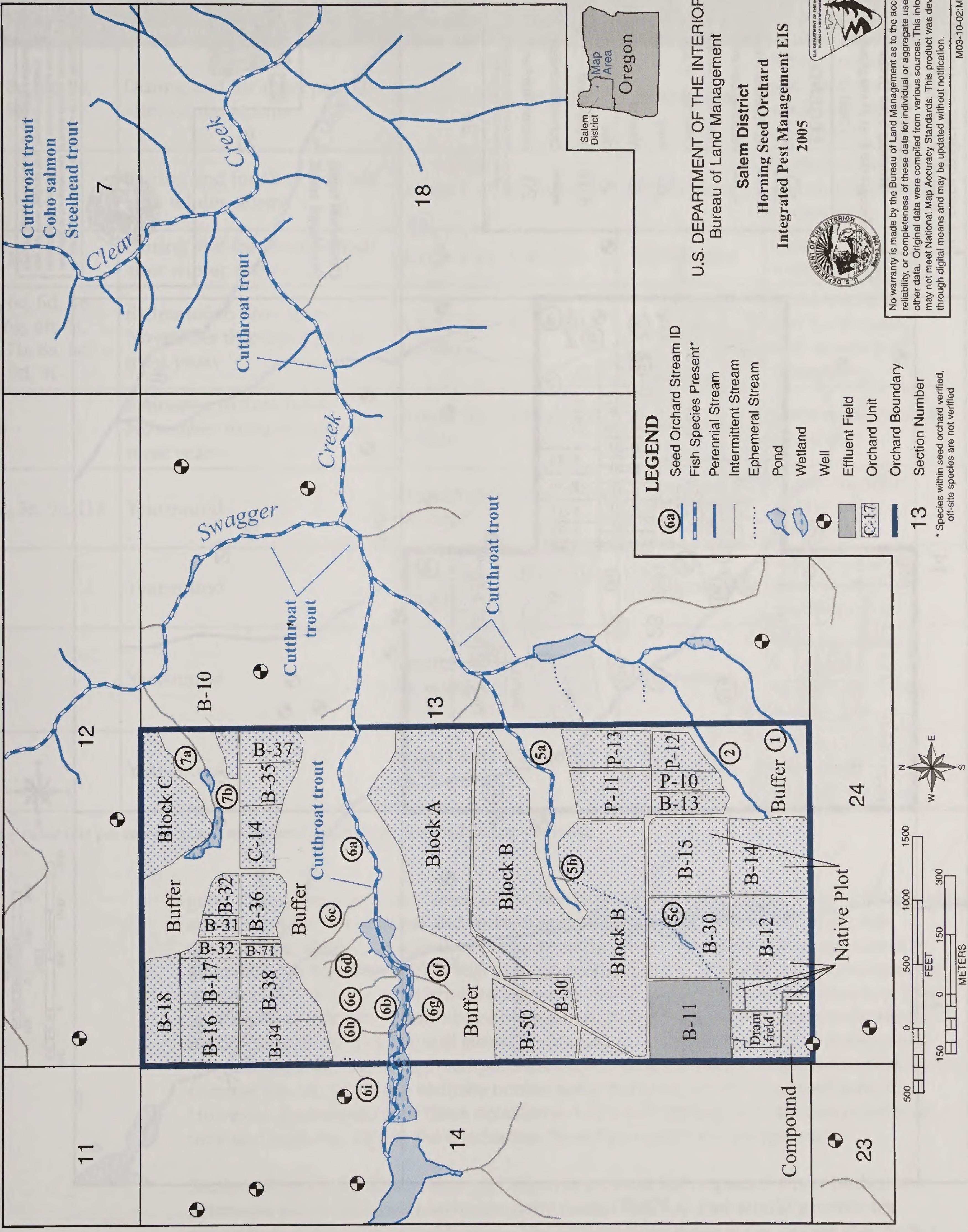


Figure 3.4-2: Water Resources at Horning- Section 23 of T4S. R3E

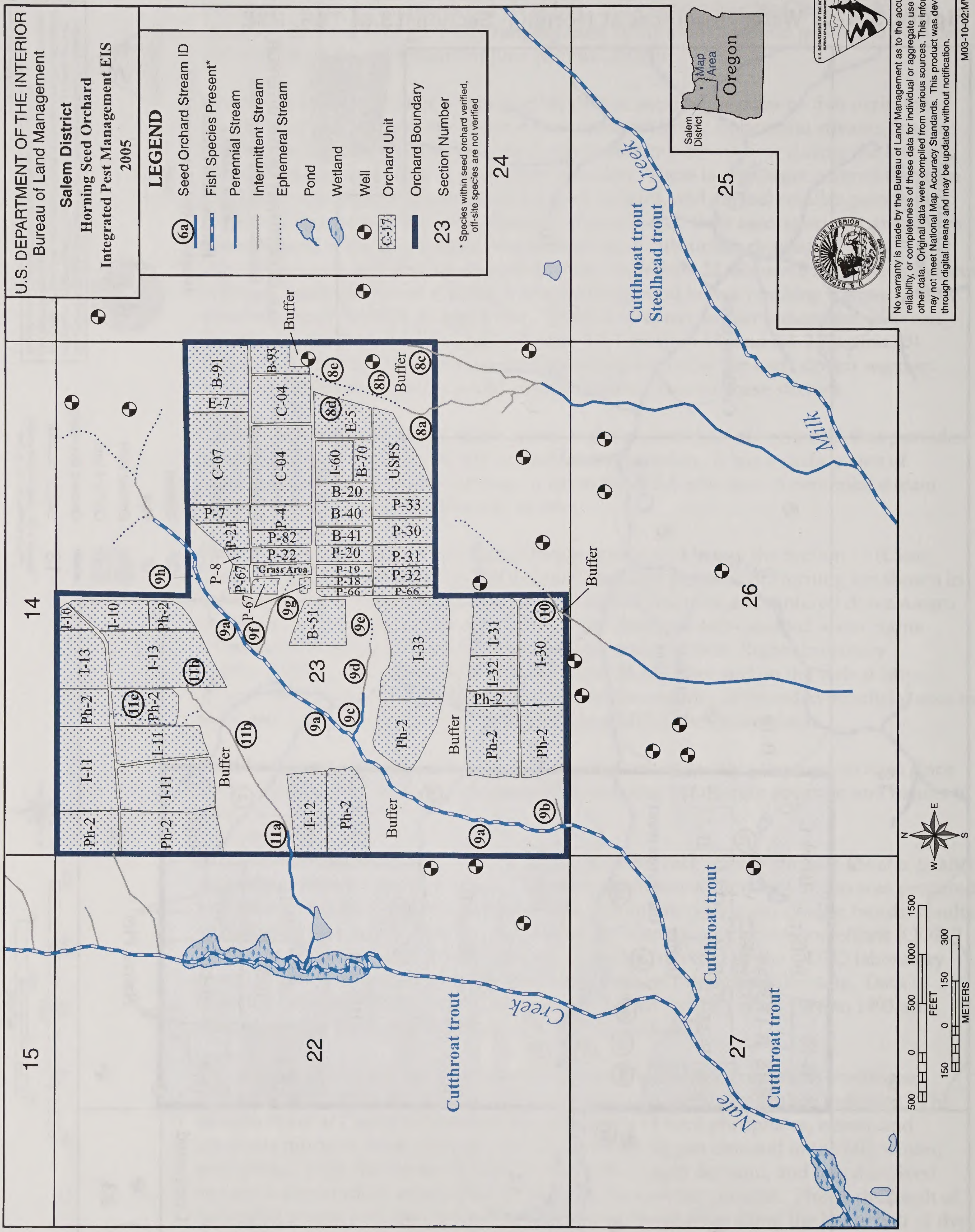


Table 3.4-1. Surface Water Information for Horning Seed Orchard

Stream # from Figures 3.4-1 and 3.4-2	Duration of Flow	Estimated Discharge/ Average Width of Channel*	Flow Type	Type of Riparian Vegetation
8b, 8d, 8e, 9e, 9g, 9h	During and for short periods after winter storms	0.2 cfs / <1 ft. width	Ephemeral	Mature conifer and hardwood; well-developed understory
5c	During and for short periods after winter storms	0.2 cfs / <1 ft. width	Ephemeral	Scattered hardwood and shrub; breaks in overstory
10, 11c	During and for short periods after winter storms	0.2 cfs / <1 ft. width	Ephemeral	Grass, minor overstory
5b, 6c, 6d, 6e, 6f, 6g, 6h, 6i, 7a, 7b, 8a, 8c, 9b, 9d, 9f	Estimated to flow from November through April in most years	0.0-0.2 cfs / 0.1 to 1 ft. width	Intermittent	Mature conifer and hardwood; well-developed understory
11b	Estimated to flow from November through April in most years	0.0-0.2 cfs / 0.1 to 1.0 ft. width	Intermittent	Scattered hardwood and shrub
1, 2, 5a, 9c, 11a	Year-round	0.2 -0.5 cfs / 1.0 to 2.5 ft. width	Perennial	Mature conifer; hardwood understory
6a	Year-round	0.5-6.0 cfs / 2.0 to 6.0 ft. width	Perennial	Mature conifer; hardwood understory
6b	Year-round	0.5-6.0 cfs / 2.0 to 30.0 ft. width	Perennial	Mature conifer; hardwood understory; many beaver dams
9a	Year-round	0.25-3.0 cfs / 2.0 to 4.0 ft. width	Perennial	Mature conifer; hardwood understory

*** cfs = cubic feet per second, based on channel dimensions observed during site visits.**

good throughout the year. Much of the sub-basin drains the Western and High Cascades and is used for silvicultural and recreational purposes. The Clackamas River has three impoundments at and above the city of Estacada. Water quality is occasionally affected by moderately high levels of biochemical oxygen demand, which indicates the introduction of organic materials to the water. Moderately high concentrations of fecal coliform and total phosphates have been noted during high flow periods, indicating runoff from fields, ditches, and storm drains carrying organic material to streams and rivers in the sub-basin. High temperatures and dissolved oxygen supersaturation during summer low flow periods indicate occasionally increased levels of eutrophication. However, the frequency of these occasional and moderate impacts has decreased over time and water quality in the Clackamas River has significantly improved.

Section 303(d) of the *Clean Water Act* requires states to list impaired water bodies and determine allowable total maximum daily loads (TMDLs) that would provide for restoration of those impaired bodies. The list identifies those water bodies that do not meet all applicable water quality standards necessary to protect beneficial uses. The

Table 3.4-2. Downstream Beneficial Uses

Water Body	Distance from Orchard	Downstream Beneficial Use[a]
Section 13		
Unnamed tributary to Swagger Creek	Perennial stream on orchard property	Resident fish rearing and spawning
Unnamed reservoir in Swagger Creek	2,500 feet	Livestock and recreation
Edna's reservoir, located in Swagger Creek	2,500 feet	Fish culture
Unnamed stream/reservoir tributary to Swagger Creek	Less than 0.5 mile	Irrigation
Clear Creek	1 mile	Winter steelhead and coho rearing and spawning[b]
Swagger Creek	1.5 miles	Irrigation/domestic
Clackamas River	27 miles	Municipal
Section 23		
Unnamed tributary to Nate Creek	Perennial stream on orchard property	Resident fish rearing and spawning
Unnamed tributary to Nate Creek	0.25 mile	Irrigation
Reservoir diversion from Nate Creek	3.5 miles	Fish culture
Milk Creek	5 miles	Winter steelhead rearing and spawning[b] (suspected)
Molalla River	25 miles	Municipal use

[a]BLM 2003, except where otherwise noted.
[b]ODFW 2002a, ODFW 2002b, Streamnet 2002

1998 ODEQ 303(d) list includes the Molalla River at its confluence with Milk Creek as water quality limited due to bacteria and temperature (approximately 19 miles below the orchard boundary); the draft 2002 303(d) list includes flow modification with the qualifier that a TMDL was not needed (ODEQ 2002b). The Clackamas River and its confluence with Clear Creek (approximately 17 miles below the orchard boundary) are listed as water quality limited for temperature (1998) and bacteria (for the period June 1 to September 30, 2002) (ODEQ 2002b).

There are no outstanding resource waters, national or state-designated wild and scenic rivers, or public watershed areas in the vicinity of the seed orchard.

3.4.3 Floodplains

Horning is located between the Clackamas and Molalla Rivers in an area of undetermined but possible flood hazards (FEMA 2002). Given its location on a topographic divide, and considerable distance from these two major rivers, the probability of flooding at the orchard is very low.

3.4.4 Drinking Water

Groundwater is the primary source for drinking water in Oregon. It is also the primary source for public drinking water supplies in the seed orchard area. Groundwater may vary significantly in elevation and depth, depending on proximity to surface waters, topographic variations, and season.

All municipal public drinking water in the vicinity of Horning is obtained from groundwater wells. One nearby resident obtains drinking water from a spring located south of Section 23. The water is diverted from the spring to the residence; however, streams on the orchard property do not contribute to the flow of this spring. There are no potable surface water intake structures in the orchard area. No municipal water intake structures occur on any surface water found in the downstream vicinity of the seed orchard (BLM 2003).

3.5 Land Use

Horning is located in Clackamas County within a rural, wooded area about 12 miles south of the Portland urban area. Neighboring land uses include small farms and acreages, timber operations, Christmas tree farms, livestock grazing, rural residences, and an organic farm. Adjacent land uses are illustrated in Figure 3.5-1. There are approximately 23 residences adjacent to or near the orchard boundary.

Clackamas County is nestled in the southeast corner of the Portland metropolitan area. The county extends from the agriculturally rich Willamette Valley in the west to the forested slopes of the Cascade Range in the east, and borders the Portland area's urban core to the north. The county is endowed with productive farmlands and forests and provides easy access to abundant recreational activities, including fishing, rafting, hiking, and skiing. Points of interest within the region include the End of the Oregon Trail Interpretive Center, Mt. Hood National Forest, and Mt. Hood herself – Oregon's tallest peak (11,235 feet), with one of the longest ski seasons in the U.S. About seven-eighths of the land area in the county is considered rural. Some of the richest farmland in Oregon is located around Canby, Sandy, Boring, Wilsonville, and Molalla, making agriculture one of the area's principal industries. Four major rivers flow through the region: the Willamette, Clackamas, Sandy, and Molalla (OED 2002, CCO 2002).

As part of the Portland-Vancouver Metropolitan Statistical Area (see Section 3.10), Clackamas County is substantially more densely settled than the U.S. average, with a population density of 181.[1] persons per square mile (USBC 2002a). Nearly 80% of the county's population is considered urban, which is comparable to Oregon and the U.S. Most of its urban population is within the larger "urban areas" rather than smaller communities,[1] with less than 12 percent in the smaller "urban clusters."

Reflecting the county's diverse nature, nearly 10% of Clackamas County's rural residents (and 2% of total residents) reside on farms, a higher proportion than either Oregon or the U.S. (USBC 2002a). Table 3.5-1 presents urban and rural characteristics for Clackamas County, Oregon, and the U.S.

Most of the lands surrounding the orchard boundary are privately owned. Lands adjacent to both Sections 13 and 23 are generally forested or agricultural, and include horse farms, small acreages supporting livestock (cattle and alpacas) operations, tree

[1] The U.S. Bureau of the Census divides "densely settled territory" into urbanized areas and urbanized clusters. "Densely settled territory" is defined as a cluster of one or more block groups or census blocks, each with a population density of at least 1,000 people per square mile, or the surrounding block groups and census blocks, with a population density of at least 500 people per square mile. Urban areas contain 50,000 or more people, while urban clusters contain between 2,500 and 50,000 people (USBC 2002b).

Figure 3.5-1: Adjacent Land Uses

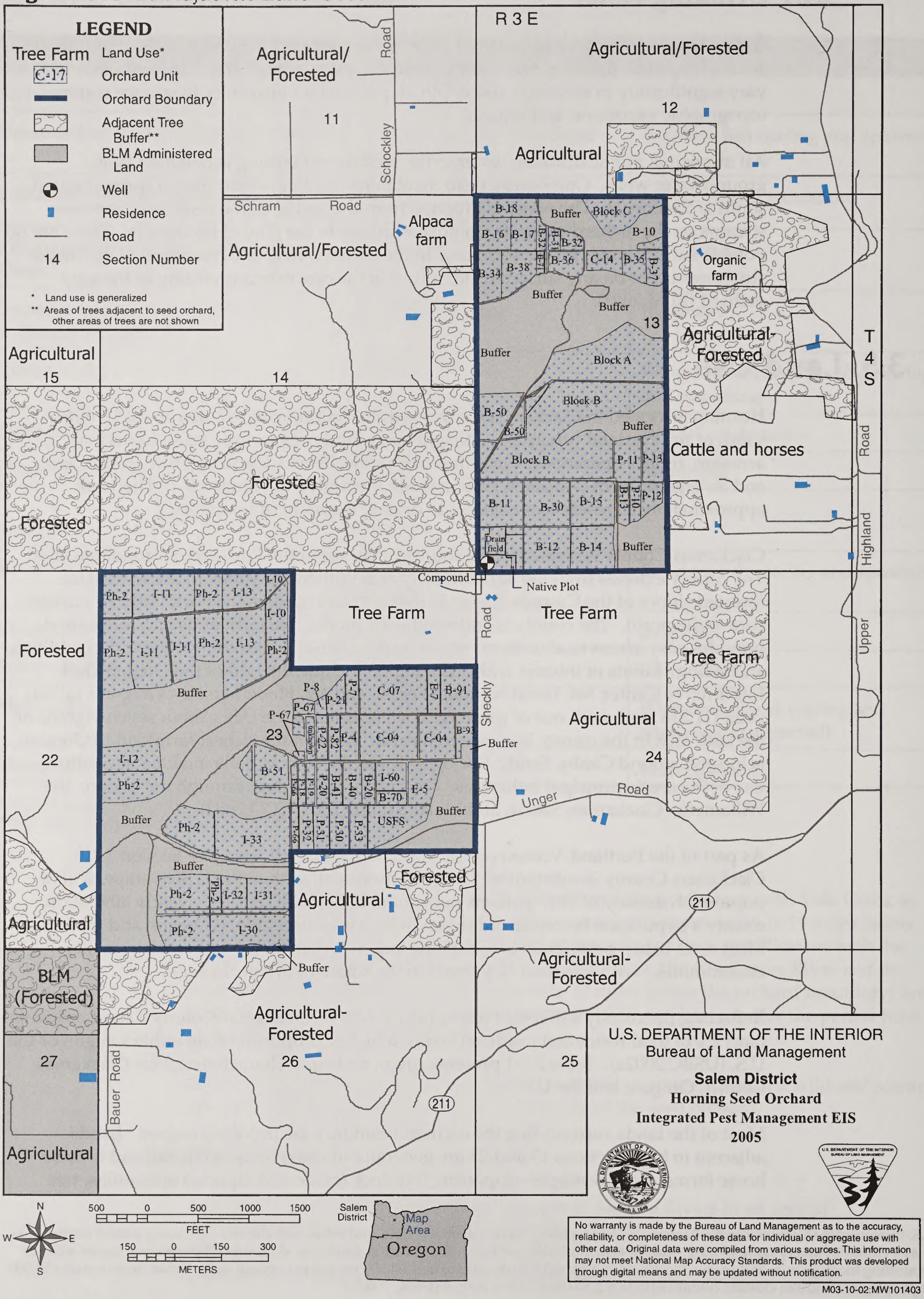


Table 3.5-1. Urban and Rural Characteristics, Clackamas County and Comparison Areas

	Clackamas County	Oregon	U.S.
Total Population	338,391	3,421,399	281,421,906
Population density[1]	181.1	35.6	79.6
Urban Population	266,559	2,692,680	222,358,309
as percent of total population	*78.8%*	*78.7%*	*79.0%*
Inside urbanized areas[2]	234,914	1,975,622	192,338,121
as percent of urban population	*88.1%*	*73.4%*	*86.5%*
Inside urban clusters[2]	31,645	717,058	30,020,188
as percent of urban population	*11.9%*	*26.6%*	*13.5%*
Rural Population	71,832	728,719	59,063,597
as percent of total population	*21.2%*	*21.3%*	*21.0%*
Farm population	6,990	64,128	2,987,531
as percent of rural population	*9.7%*	*8.8%*	*5.1%*
Nonfarm population	64,842	664,591	56,076,066
as percent of rural population	*90.3%*	*91.2%*	*94.9%*

Data source: USBC 2002a.
[1]Population density (persons per square mile) is calculated by dividing total population by total land area.
[2]USBC divides "densely settled territory" into urbanized areas and urbanized clusters. "Densely settled territory" is defined as a cluster of one or more block groups or census blocks, each with a population density of at least 1,000 people per square mile, or the surrounding block groups and census blocks, with a population density of at least 500 people per square mile. Urban areas contain 50,000 or more people, while urban clusters contain between 2,500 and 50,000 people (USBC 2002b).

farms, Christmas tree farms, small residential acreages, and a certified organic farm that grows herbs and mushrooms.

Horning encompasses 800 acres, of which 320 acres are in Section 13 and 480 acres are in Section 23. Figure 2.1-1 illustrates land use on the orchard property, and Table 3.5-2 shows orchard acreages by type of use.

3.6 Human Health

3.6.1 Public

Horning is located in a rural area with little nearby development and few close neighbors. Aerial photographs were examined to determine approximate distances to nearby residences (BLM 1999). Approximately 23 residences were identified adjacent to or near the seed orchard. Figure 3.5-1 illustrates the surrounding land uses.

Horning and its immediate surroundings lie within Clackamas County Census Tract 236 (Blocks 2022, 2037, 2038, 2039, and 2040) and Census Tract 241 (Blocks 1000, 1013, and 3025) (ESRI 2002).[2] Population data were assessed for these blocks to determine

[2] The USBC divides counties into census tracts, which are subdivided into block groups, which are further subdivided into census blocks. The relative geographic size of these units is determined by their population; the greater the population, the more subdivisions each unit will have, and hence the subdivisions will be relatively smaller. The USBC attempts to divide a county in such a manner that sub-units within a larger unit will have approximately similar populations; however, migration in and out of an area will affect this balance over time and can result in "empty" census blocks.

Table 3.5-2. Horning Seed Orchard Land Use

Description	Acres
Planted Developed Orchard Acreage	
Douglas-fir seed production orchards (B Orchards)	42
Douglas-fir seed production orchards (I Orchards)	96
Multi-species seed production orchard	39
Breeding and preservation orchard	69
Native plant grow-out beds	40
Seedling seed production orchards (C orchards)	45
Subtotal	331
Other Acreage	
Developed but fallow (Phase II, second generation)	52
Non-usable buffer zones (mostly riparian areas; also includes certain areas unsuitable for cultivation due to slope or other factors)	392
Roads	15
Administrative site (buildings, grounds, and parking area)	10
Subtotal	469
Total	800

population numbers near the orchard and identify any sensitive sub-populations, such as young children or the elderly. Census Blocks 2037, 1000, and 1013 contain no residents. Table 3.6-1 shows relevant demographic characteristics for the remaining census blocks (in total), along with county, state, and U.S. figures for comparison. As the table shows, the median age for the area surrounding the orchard is higher than the comparison areas, while the percentages of young children (under age 5) and the elderly (above age 65) are lower. However, the proportion of older children (ages 5-14) and teens (ages 15-19) is higher than the comparison areas (USBC 2002a).

Table 3.6-1. Selected Demographic Characteristics

	Total for Adjacent Blocks[1]	Clackamas County	Oregon	U.S.
Total population	312	338,391	3,421,399	281,421,906
Total households	103	128,201	1,333,723	105,480,101
Median age[2]	41.5	37.5	36.3	35.3
Age distribution				
Under 5 years	3.8%	6.0%	6.5%	6.8%
5 To 14 years	15.1%	14.0%	13.9%	14.6%
15 To 19 years	8.7%	7.2%	7.1%	7.2%
20 To 44 years	26.6%	31.5%	35.9%	37.0%
45 To 64 years	36.5%	25.4%	23.7%	22.0%
Over 65 years	9.3%	16.0%	12.8%	12.4%

Data source: USBC 2002a.
[1]Census Tract 236 (Blocks 2022, 2037, 2038, 2039, and 2040) and Census Tract 241 (Block 1000, 1013, and 3025).
[2]Median age for the combined "Adjacent Blocks" is estimated using a weighted average technique.

The seed orchard is open to the public Monday through Friday from 7:30 to 4:00, except for Federal holidays. Visitors are required to check in and out at the office. The typical visitor is on an educational tour that has been arranged in advance by a local institution or group, such as the Portland Public Schools, Clackamas Community College, Mt. Hood Community College, Small Woodland Owners Association, Northwest Seed Orchard Managers Association, or Oregon State University. Tour groups typically vary in size from 2 to 30 people, although there were 115 elementary school children in a 2001 tour.

A commercial Christmas tree grower has a right-of-way agreement to use Horning's on-site roads to access one of its farms located on the north side of Horning, in the northwest corner of Section 13. Access is limited to late October through mid December during normal business hours.

The orchard provides training opportunities for minimum security inmates from the nearby Sheridan Federal Correctional Institute and for student interns. The inmates perform a variety of horticultural activities. The composition of inmate labor teams varies according to orchard labor needs at the time and inmate availability, and few inmates work regularly at the orchard for more than a few months at a time. In 2001, the inmates spent 284 hours at the seed orchard. Young people from a variety of youth-at-risk programs serve as interns at the orchard, and are scheduled to work from three or four days to several weeks per year.

Horning also participates in Experience International, a training program that allows students from outside the U.S. to work at the orchard and its greenhouse to learn horticultural practices and orchard management. An intern from Bulgaria is currently residing in the bunkhouse at Horning as part of this program.

Horning is investigating the establishment of a "host" volunteer agreement with an individual, perhaps employed by a local law enforcement agency, who would be allowed to live on the orchard property in return for providing security when the orchard is closed. Currently, no such individual resides on the orchard property.

Horning has an active public outreach program, which includes a display of native conifers, visits to local schools, and educational tours of the orchard featuring demonstrations on orchard, forestry, wildlife, and fisheries topics. About five times per year, local horseback riding and carriage clubs schedule events, generally on weekends between May and September. These events are authorized under special recreation permits and are restricted to gravel roads within the orchard acreage or trails on adjacent private property.

3.6.2 Workers

Horning has eleven full-time employees who work 40 hours per week year-round; workers may follow flex-time schedules to complete 40 hours in less than five days within a given period. The orchard also has one permanent part-time employee, who works 32 hours per week year-round, and two seasonal employees, who work between nine and 12 months per year. A retired BLM employee volunteers 20 to 40 hours per week year-round, working mostly in the greenhouse. The length of orchard employment for Horning's current employees ranges from 10 to 27 years.

3.7 Biological Resources

The following sections describe the vegetation, terrestrial wildlife, and aquatic species found at and near Horning. In addition to the abundant or common species observed,

several species present or potentially present at Horning have a special status under Federal or state laws or recommendations. These species include four birds, one reptile, and three fish, as listed in Table 3.7-1.

The Federal ESA applies to all actions on all lands, whether they are undertaken by Federal agencies, state agencies, commercial entities, or private individuals. Species of concern are designated by the Oregon state office of FWS. These species receive no legal protection. Many species of concern are former Category 2 species that were candidates for listing under the ESA until 1996. Category 2 candidate species were those species for which information indicated that a proposal to list the species as endangered or threatened was possibly appropriate, but sufficient data on biological vulnerability and threats were not available to support proposed rules.

The Oregon *Threatened and Endangered Species Act* applies only to actions of state agencies on state-owned or leased lands, and therefore its regulatory scope does not extend to the proposed activities at the seed orchard. However, these species are evaluated as special status species in this EIS. ODFW also maintains a "watchlist" of species that might qualify for state listing in the future. These species may be designated as critical, vulnerable, peripheral or naturally rare, or of undetermined status.

BLM has three designations that may be applied to particular species. "Bureau Sensitive" species include species that could easily become endangered or extinct in a state; and are not listed, proposed, or candidate species under Federal laws, but are eligible. "Bureau Assessment" species are plant or animal species that are not presently eligible for official Federal or state status but are of concern. "Bureau Tracking" species act as an early warning for species which may become of concern in the future; BLM districts are encouraged to collect information on these species, but they are not considered special status species for management purposes. The State of Oregon has state-listed species, and these are on the BLM special status species list, as "State Listed."

Special status species are described within the appropriate sub-section below.

Table 3.7-1. Special Status Species at or Near Horning

Species	Federal Status	State Status
Steelhead trout (*Oncorhynchus mykiss*)	Threatened	Sensitive-vulnerable
Oregon vesper sparrow (*Poocetes gramineus affinis*)	Species of concern (FWS) Sensitive (BLM)	Sensitive-critical
Streaked horned lark (*Eremphila alpestris strigata*)	Species of concern (FWS) Sensitive (BLM)	Sensitive-critical
Pacific lamprey (*Lampetra tridentata*)	Species of concern (FWS)	Sensitive-vulnerable
Western pond turtle (*Clemmys marmorata*)	Species of concern (FWS) (Northwestern subspecies only) Sensitive (BLM)	Sensitive-critical
Common nighthawk (*Chordeiles minor*)	Sensitive (BLM)	Sensitive-critical
Western meadowlark (*Sturnella neglecta*)	Sensitive (BLM)	Sensitive-critical
Cutthroat trout (*Oncorhynchus clarki clarki*)	Sensitive (BLM)	Sensitive-critical

3.7.1 Vegetation

Orchard Areas

Horning is a plantation for the seed production of Douglas-fir, western hemlock, western red cedar, western white pine, noble fir, and sugar pine. Managed stands of these species are scattered in small even-aged patches throughout the seed orchard. These areas were cleared or tilled of native vegetation and replanted with the desired species. The understory in these areas is dominated by grasses with some areas of forbs. Little woody debris is present on the forest floor. Giant sequoia have also been planted along the orchard perimeters or fence lines as wind and pollen barriers.

Riparian Areas

Riparian buffers at Horning contain scattered stands of mid-age conifer stands that were salvage- logged in the past. As a result of prior management, these areas lack old-growth trees and large snags; however, they contain higher diversity than the orchard areas. The canopy of these stands is dominated by Douglas-fir and western red cedar, with an understory of western hemlock, red alder, bigleaf maple, California hazel, cascara, vine maple black cottonwood, and Pacific dogwood. Common shrubs in the understory include salal, thimbleberry, and red huckleberry.

At a few locations adjacent to the riparian areas or within mid-age conifer stands, there are patches of pure hardwood trees.

Shrublands

Shrublands occur at two locations within the orchard where areas were logged for plantations, but were never cleared. These areas were allowed to grow into dense patches of hazel, cascara, red alder, blackberry, and Scotch broom, with a few scattered Douglas-fir.

Upland Meadows

The upland meadows at Horning are all man-made, created by clearing the native forest and allowing these areas to be invaded by grass. A few Douglas-fir are found in some of the meadows. Mowing is used occasionally to reduce ground cover. These areas are generally transitional, with replanting to consist of trees as more seed orchard is needed.

Wetlands

Small wetland areas are found at the head of some of the small streams that run through the seed orchard and around the small pond at the site. Various species of sedges, rushes, and pondweeds are found at these areas.

Noxious Weeds

Several noxious weed species have been documented at Horning, including Himalayan blackberry, evergreen blackberry, butter and eggs, bull thistle, Klamath weed, Canada thistle, tansy ragwort, and Scotch broom.

Special Status Plants

No special status plant species are known to occur at Horning.

3.7.2 Terrestrial Species

The wildlife on the seed orchard grounds consist mainly of animal species that are adapted to early-successional vegetation environments and are tolerant of disturbance. Eight habitat types can be found within the 800-acre seed orchard. These range from highly managed upland meadows to mid-age conifer stands. Most of the land has been disturbed in some fashion in the past. Approximately 300 acres (40% of the orchard) is covered with stands of young (1 to 30-year-old) conifers that are evenly spaced with no shrubs or woody debris. These areas have each at some time been completely tilled, and the groundcover now consists of managed grasses and some forbs. Another 160 acres (20% of the orchard) is covered with upland meadows that are periodically mowed. These two highly managed habitat types serve as early successional environments for wildlife.

Even though more than half of the site is highly managed, small areas of diverse habitat such as ponds (one acre) and wetlands (three acres) provide environmental conditions important to many species of wildlife. Six narrow bands of riparian corridor (20 acres) and patches of hardwood (five acres) support the majority of the wildlife present. Mid-age conifer stands (180 acres) are scattered directly next to the riparian habitat and add to the riparian diversity. About 60 acres are covered in thick shrub patches. These patches were once cleared for plantations, but were never used and grew thick with tall shrub species and an occasional tree.

The plantations within the orchard are enclosed by a perimeter fence. This perimeter partially or completely excludes many wildlife species that occur in the surrounding habitats. Particularly, large mammals such as deer, elk, black bears, and mountain lions are excluded by the fence. However, other species have been encouraged to use the orchard grounds with nesting or roosting box installations. These flying species include bats, swallows, bluebirds, and wrens.

Deer occupy the limited unfenced areas on the site. These include riparian habitats that are used for thermal cover, and shrub patches which provide high quality cover and foraging areas. Medium-sized animals such as coyotes, rabbits, and raccoons prefer to utilize these dense habitats rather than the more open areas such as the meadows or the young conifer stands. These denser riparian areas are usually located next to wetland habitats, streams, and ponds, which the larger mammals use as water sources. The wetland areas are inhabited by beavers that forage and collect building materials in the surrounding shrub and riparian areas. These mammals have altered the stream channels and have formed several ponds along the streams.

Denser riparian and wetland areas provide habitat for an assortment of small mammals. But unlike the larger mammals that remain in or close to the denser shrubby areas, small mammals are found all over the site, including the open upland meadows and young conifer stands. The short ground cover in the young conifer stands provides habitat for gophers, voles, and moles, which are also common in the surrounding areas. Small mammals forage in the low ground cover of the meadows.

Aside from mammals, other small species inhabit the denser and moister areas of the seed orchard. Amphibians are present in the moist environment of the wetland areas. Frogs and salamanders breed in the ponds and wetland areas. Frogs inhabit the riparian habitats. Reptiles also occur on the orchard grounds. Garter snakes can be found in the stands of young conifers.

The most visible inhabitants of the orchard are birds. A large variety of bird species nest, breed, and forage at Horning. Canada geese, and water birds such as mallard ducks, use the wetland areas and ponds for breeding, nesting, and foraging. Some ground-nesting species utilize the short ground-cover of the meadows and plantations in the spring

and summer. The woody and riparian habitats provide nest areas for a variety of birds, including raptors. These raptors forage for prey in the surrounding grasslands and more open young conifer stands. Raptors on the orchard grounds include red-tailed hawks, great-horned owls, and kestrels. A large number of song birds and neotropical bird migrants inhabit the riparian and woody habitats during nesting season or year-round. Some of the species that prefer the riparian areas include grosbeaks, song sparrows, cedar waxwings, and spotted towhees. Pileated woodpeckers, flycatchers, kinglets, brown creepers, and varied thrushes can often be found nesting in the woody areas of the mid-age conifer stands, while hummingbirds and some song birds prefer to nest in the dense cover of the shrub patches.

Special Status Terrestrial Wildlife Species

The Oregon vesper sparrow (*Poocetes gramineus affinis*) is a FWS species of concern and a BLM sensitive species. This sparrow was formerly common throughout the Willamette Valley, but has largely disappeared from much of its northwest Oregon range. Recent studies indicate that Christmas tree farms, especially those in which weeds and grass are not as frequently controlled, provide usable habitat structure and food for this species. Small trees or low shrubs for singing perches; some percentage of area in bare ground, grass, and other weed seeds; and insects are all important habitat components for this species. Parts of Horning would provide suitable breeding habitat for vesper sparrows.

The streaked horned lark (*Eremphila alpestris strigata*) is a FWS species of concern and a BLM sensitive species. This subspecies inhabits open fields, particularly with bare ground or sparse vegetation, and nests and forages on the ground. It could use newly created plantations at Horning that have been tilled or mowed, and the adjacent edge habitat in older plantations. It may occur in meadow areas, particularly those that have been grazed or mowed. It is very rare in the Willamette Valley.

The western pond turtle (*Clemmys marmorata*) is an Oregon state-listed sensitive species and BLM sensitive species. Although it is unknown if they occur at Horning, the water temperature in the stream above the reservoir was 63 °F when measured during the early spring of 1999, which is warm enough to support turtles. They prefer habitat to be a combination of quiet and fairly clear water, with emergent rocks or logs that serve as basking areas, some aquatic vegetation, and nearby sunlit ground. Lack of basking areas, emergent vegetation, and siltation are limiting factors that may preclude them from using Horning's aquatic and riparian habitats. The subspecies northwestern pond turtle (*Clemmys marmorata marmorata*) is also a Federal species of concern.

The common nighthawk (*Chordeiles minor*), a BLM sensitive species and state-listed sensitive species, is becoming increasingly rare in the Willamette Valley. Nighthawks feed over a wide range of habitat types, particularly wet areas which produce a large insect population. They are ground nesters in open areas, occasionally on little used roads, clearcuts, and landings. However, since most of the roads and open areas at Horning are subject to high levels of human disturbance, nesting at the seed orchard is unlikely.

The western meadowlark (*Sturnella neglecta*) is a BLM sensitive species that inhabits open grasslands, pastureland, and open woodlands. It perches on short trees, shrubs, and fence posts, and is a ground nester in medium to high grass. Meadowlarks are becoming increasingly rare in the Willamette Valley during the nesting season, but can be seen in open pasture grassland in large flocks in the winter.

3.7.3 Aquatic Species

Horning serves as the headwater area for a number of small streams within its boundaries. Figures 3.4-1 and 3.4-2 show maps of stream locations and fish distribution within and in the vicinity of Horning.

Streams in the Section 13 portion of Horning flow into Swagger Creek, a tributary to Clear Creek, which flows into the Clackamas River. Fish species which may be present in the Clear Creek drainage include winter steelhead, coho salmon, chinook salmon, cutthroat trout, reticulate sculpin, largemouth bass, western brook lamprey, and Pacific lamprey. Largemouth bass have been observed in the irrigation pond and in Stream 6a above the irrigation pond, but do not constitute a major fishery; it is suspected that they came from an upstream millpond on private land.

Streams in the Section 23 portion of Horning flow into Nate Creek, a tributary to Milk Creek, which flows into the Molalla River. This section of the seed orchard is bisected by the headwater segment (Stream 9a) of Nate Creek. Fish species that may be present in the Milk Creek drainage include fall chinook salmon, coho salmon, winter steelhead, cutthroat trout, sculpins, and western brook lamprey. In 1983, coho salmon were observed in Nate Creek about two miles downstream of Horning (ODFW 2002a). Hatchery releases of coho salmon into the upper Willamette River basin were discontinued in 1988, and viable coho runs are not thought to still occur. It is not known if the coho salmon observed in 1983 were spawned naturally or if they were released from a hatchery.

There is no habitat for any anadromous fish on the seed orchard. Resident cutthroat trout is the only salmonid species that occurs on the orchard property. Cutthroat trout are found in Nate Creek tributary Stream 9a and in Swagger Creek tributaries Streams 5a and 6a. A survey of Stream 9a, conducted in June 1999, found cutthroat trout and sculpin in the perennial reaches of the stream within the seed orchard. Cutthroat trout have also been collected below a barrier dam at the orchard's irrigation pond on Stream 6a within Section 13 (see Figure 3.4-1). No cutthroat were collected upstream of the dam, but it is likely that they are found in the irrigation pond and further upstream. Cutthroat are also found in the perennial portions of Stream 5a.

Crayfish were collected in the perennial reaches of Streams 6b (Section 13) and 9a (Section 23) within the seed orchard boundaries. The intermittent streams at the orchard do not support fish.

Special Status Aquatic Species

<u>Steelhead Trout</u>

Certain distinctive groups, termed evolutionarily significant units (ESUs), of anadromous rainbow trout (*Oncorhynchus mykiss*) are listed as threatened under the ESA. Steelhead are the anadromous members of this species, meaning that they migrate from the ocean to spawn in fresh water. Members of this species may also have a life cycle completely in fresh water; these fish are commonly called rainbow or redband trout, and are not included under the ESA listing. Steelhead eggs incubate in gravel nests in freshwater rivers, and then hatch as the larval stage called alevins, who depend on food stored in a yolk sac. After the yolk sac is absorbed, juvenile steelhead emerge from the gravel nest as fry and live in fresh water for one to two years, after which they migrate to the ocean as smolts. Typically, they will spend two to three years in the ocean before returning to spawn in the river where they were hatched. Unlike other Pacific salmon, steelhead may spawn more than once before they die.

The Lower Columbia ESU includes all naturally spawned populations of steelhead in streams and tributaries to the Columbia River between the Willamette and Hood Rivers in Oregon, and the Cowlitz and Wind Rivers in Washington; this ESU was listed as threatened under the ESA on March 19, 1998 (63 FR 13347). The Upper Willamette River ESU—which includes all naturally spawned winter-run populations of steelhead in the Willamette River and its tributaries, from Willamette Falls to the Calapooia River—were listed as threatened under the ESA on March 25, 1999 (64 FR 14517).

Upper Willamette steelhead trout are native to Milk Creek and are present approximately five miles downstream from Horning at the confluence with Nate Creek (ODFW 2002a). There is a 1983 record of coho salmon in Nate Creek; however, there are no records indicating that steelhead utilize this stream. Although steelhead are found in Milk Creek to the southeast of the orchard, there are no surface flowing tributaries that connect the orchard to this part of Milk Creek. In addition, steelhead from the Lower Columbia River ESU are present in Clear Creek in the vicinity of its confluence with Swagger Creek, approximately one mile downstream from Horning (ODFW 2002b). Upstream migration of steelhead in Clear Creek is blocked by barrier falls on both forks just above the confluence of Clear Creek and the north fork of Clear Creek, approximately two miles above the Swagger Creek confluence. It is not known if steelhead use Swagger Creek, but the very lower portion of Swagger Creek appears to be accessible; Swagger Creek is not identified as steelhead habitat by ODFW. There appears to be a topographic barrier to upstream fish movement on Swagger Creek about 0.5 miles above the confluence with Clear Creek, on private land. Based on a USGS topographic map, the elevation change is approximately 300 feet within less than 1/4 mile.

<u>Chinook salmon</u>

Populations of Lower Columbia and Upper Willamette chinook salmon (*Oncorhyncus tshawytscha*), a Federally listed threatened species, are found 12 miles downstream from the seed orchard in Clear Creek and 15 miles downstream in Milk Creek, respectively. These fish utilize the lower portions of Clear Creek and Milk Creek for spawning and rearing purposes, but do not use the upper portions of the watersheds.

<u>Other Special Status Aquatic Species</u>

The Pacific lamprey (*Lampetra tridentata*) may be present in the Clear Creek drainage. This fish is a FWS species of concern and a state-listed sensitive species.

Anadromous (sea-run) cutthroat trout (*Oncorhynchus clarki clarki*) in Clear Creek, approximately one mile downstream from the orchard, are a BLM sensitive species and state-listed sensitive species. These fish are part of the Southwestern Washington/ Lower Columbia River distinct population segment. (The FWS use of the term "distinct population segment" is equivalent to the NOAA Fisheries term ESU.)

Naturally spawned populations of Lower Columbia River/SW Washington ESU coho salmon (*Oncorhynchus kisutch*), a Federal candidate species and state-listed endangered species, are found approximately one mile downstream from the orchard in Clear Creek. Very little information is available for coho salmon in Clear Creek. The primary production area for this ESU occurs in the Clackamas River above North Fork Reservoir.

Resident cutthroat trout found on the orchard property, and coho salmon found in the Milk Creek drainage, are not considered to be FWS or state species of concern or BLM-sensitive.

Essential Fish Habitat

Pacific salmon habitat that is found in Clear Creek, Nate Creek, and Milk Creek has been identified as freshwater EFH for chinook and coho salmon (Pacific Fishery Management Council 1999). Coho salmon habitat is located approximately one mile downstream of the orchard in Clear Creek, and two miles downstream in Nate Creek. Chinook salmon habitat is found 12 miles downstream from the orchard in Clear Creek and 15 miles downstream in Milk Creek. The upstream extent of EFH in these streams is based primarily on the known or historic distribution of coho salmon. NOAA Fisheries is charged to designate and protect EFH in accordance with the provisions of the *Magnuson-Stevens Fishery Conservation and Management Act*, as amended by the *Sustainable Fisheries Act* of 1996.

3.8 Noise

Noise is defined as any unwanted sound that interferes with normal activities or in some way reduces the quality of the environment. Ambient noise levels vary greatly in magnitude and character from one location to another, depending on the normal activities conducted in the area. In general, noise levels around Horning result primarily from traffic and agricultural and timber operations.

3.8.1 Noise Descriptors

Community response to noise is not based on a single event, but on a series of events over the day. Factors that have been found to affect the subjective assessment of the daily noise environment include the noise levels of individual events, the number of events per day, and the time of day at which the events occur. Most environmental descriptors of noise are based on these three factors, although they may differ considerably in the manner in which the factors are taken into account. Two types of noise measures are used to describe impacts on an existing environment. These include the decibel and the equivalent sound level. These measures and their application to noise environments are discussed below.

A decibel (dB) is the physical unit commonly used to describe sound levels. Sound measurement is further refined by using an "A-weighted" decibel (dBA) scale that emphasizes the audio frequency response curve audible to the human ear. Thus, the dBA measurement more closely describes how a person perceives sound. For example, typical noise levels include a quiet urban nighttime (40 dBA), an air conditioner operating 100 feet away (55 dBA), and a heavy truck moving 50 feet away (85 dBA). Table 3.8-1 shows noise levels for various human activities.

Typical noise at the orchard generated by trucks, tractors, mowers, and other power equipment is described over an eight-hour time period, using the equivalent sound level (L_{eq}). L_{eq} is calculated using the dBA levels of noise events averaged over time, taking into account the usage factor (the proportion of time that a maximum level of noise is generated) of various types of equipment. Table 3.8-2 provides approximate sound levels for a typical mix of orchard equipment, estimated with L_{eq}.

Helicopter sound levels have been estimated for a helicopter 30 feet off the ground, with an averaging time of eight hours; the estimated noise levels are 85, 79, 73, and 67 dBA at 600, 1,200, 2,400, and 4,800 feet, respectively (U.S. Army 1976, Cavanaugh 1998, Cunniff 1977). This estimate also assumes a background noise level of 45 dBA for a typical rural area (Cavanaugh 1998).

Table 3.8-1. Typical Decibel Levels Encountered in the Environment

Sound Level (dBA)	Source of Noise	Subjective Impression
10	--	threshold of hearing
20	rustling leaves	
30	quiet bedroom	
35	soft whisper at 5 ft; typical library	
40	quiet urban setting (nighttime); normal level in home	threshold of quiet
50	light traffic at 100 ft; quiet urban setting (daytime)	
55	--	desirable limit for outdoor residential area use
65	automobile at 100 ft	acceptable level for residential land use
70	pickup truck at 50 ft; Freight train at 100 ft	threshold of moderately loud
80	tractor at 50 ft; power saw at 50 ft	most residents annoyed
85	heavy truck at 50 ft; helicopter flyover at 30 ft altitude at 600 feet distance	threshold of hearing damage for prolonged exposure
95	freight train at 50 ft; large lawn mower	
100	heavy diesel equipment at 25 ft; chainsaw	threshold of very loud
120	jet plane taking off at 200 ft	threshold of pain
135	civil defense siren at 100 ft	threshold of extremely loud

Sources: 14 CFR 36.805, Cavanaugh 1998, Suter 1991, U.S. Army 1976, EPA 1974

Table 3.8-2. Approximate Sound Levels (dBA) of Orchard Equipment

Equipment	Averaging Time	Sound Levels (dBA) at Various Distances (ft)[a]					
		50	100	200	400	800	1,600
Chain saw	8 hours	101	95	89	83	77	71
Mower	8 hours	90	84	78	72	66	60
Tractor	8 hours	79	73	67	61	55	49
Power saw	8 hours	73	67	61	55	49	43
Pickup truck	8 hours	66	60	54	48	42	36
Composite	8 hours	75	69	63	57	51	45
Composite	24 hours	78	72	66	60	54	48

[a]Noise attenuation of 6 dBA for each doubling of distance assumes flat terrain with no trees or buildings. Trees and buildings would increase the attenuation, reducing noise levels at various distances. Assumes a background noise level of 45 dBA for a typical rural (farm) area (Cavanaugh 1998)

Sources: U.S. Army 1976, Cavanaugh 1998, Cunniff 1977.

Noise generated near the ground generally attenuates 6 dB for each doubling of distance from a noise source; trees and terrain can further increase attenuation. Noise generated above ground level (above 50 ft) generally attenuates about 2 dB for every doubling of distance. Attenuation of outdoor noise sources is complex, influenced by atmospheric conditions (wind speed and direction, relative humidity, and cloud cover), topography (flat terrain versus hills and mountains), tree cover, and other barriers such as buildings.

3.8.2 Existing Noise Environment

Horning is located in an area of small farms and acreages, timber operations, and forested areas about 12 miles south of the Portland urban area. Typical ambient noise levels for the mix of land use would average around 45 dBA.

About 23 residences are within ¼ mile of the orchard. There are buffers of trees between the orchard and about half of these residences.

Noise at Horning is generated by trucks, tractors, and power equipment used for daily operations. Typically, a mix of equipment would intermittently generate around 75 dBA at a distance of 50 feet, averaged over an eight-hour period. Not including the effects of terrain and trees, these estimated noise levels would be expected to attenuate to 69 dBA at 100 feet and to 45 dBA at 1,600 feet (see Table 3.8-2).

Neighboring timber companies and Christmas tree farms use helicopters for pesticide applications (BLM 2002). Several small airports and landing strips are also located in the vicinity of Horning, with the closest one about five miles north of the seed orchard. Various types of helicopters and fixed-wing aircraft contribute intermittent noise to the noise environment in the vicinity of the seed orchard.

3.9 Cultural Resources

While no prehistoric archeological materials have been found in the seed orchard itself, reports of prehistoric artifacts on private lands in the surrounding two miles indicate that the area around the seed orchard was used by native people prior to Euro-American settlement. Artifacts reported from these private lands include stone flakes, scrapers, and one grinding stone. At least three and possibly four sites may be within the vicinity, with one possible site less than one-half mile away.

During the period of Euro-American settlement, Kalapuyan and Molalla Indians inhabited this area. The Kalapuya focused much of their subsistence activities on the Willamette Valley, the Cascade and Coast Range foothills, and the lower reaches of Willamette River tributaries. The Molalla Indians inhabited the Cascade Mountains, usually at higher elevations than the Kalapuya, with winter camps in the area of the seed orchard, along the lower reaches of the Molalla River. The Kalapuya were known to have practiced burning as a means of manipulating vegetation for plant production and hunting purposes. Whether the lands at Horning were purposefully or periodically burned is unknown.

Euro-American settlement in the lands around Horning was well underway by the 1850s, but no land claims were made within the present boundaries of the seed orchard. Logging and lumbering became important in this area in the early part of the twentieth century. Starting in 1920, large portions of the seed orchard were logged by the Molalla Lumber Company (later the Clackamas Eastern Railway). Molalla Lumber built railroad logging lines and spurs over much of this area. A.F. Lowes Lumber Co. and John Buche continued logging efforts through 1956.

Railroad rights-of-way were granted to Molalla Lumber in 1930 to cross portions of what is now the seed orchard. However, lumber companies were operating in the area long before the railroad was built. The Clackamas Fir Lumber Company built a large sawmill in Section 15 around 1920, and by 1928, the Molalla Lumber Co. was running a sawmill in adjacent Section 14. Clackamas Eastern Railway grades cross Horning and are visible in some locations. (In Section 23, a locomotive headlight was reportedly found many years ago near a creek; rumor has it that a train derailed on the south side of the creek in this area.) Logging continued as an important part of the local economy and as a land use in the area until very recent times, if not today.

Numerous small sales for firewood, posts and poles, cull logs, saplings, and cedar posts took place in the area, concentrated particularly in the early1940s, although continuing into the 1950s. Grazing leases were in effect over much of what would become Horning, starting in 1946 and continuing through 1956.

Three systematic cultural resource inventories have been conducted on various portions of the seed orchard. Inventories C795 (in 1977), C8113 (in 1981), and C859 (in 1983) did not locate any significant historic or prehistoric sites or materials. The surveyor did note the visible presence of the Clackamas Eastern Railway grade. These railroad remnants are isolated from other extant portions of the railroad system. As such, these segments do not retain their integrity and are not eligible for the National Register of Historic Places (NRHP). While evocative of an earlier era of land use, these railroad grade segments do not contribute additional knowledge to understanding the past.

3.10 Socioeconomics and Environmental Justice

Socioeconomic resources are described in this section using employment, income, and demographic measures. Economic and demographic elements are key factors influencing changes in demand for goods and services within a local economy. Because there are no personnel changes associated with the proposed action or alternatives, the local housing market, schools, community services, and infrastructure will not be discussed in this document.

Horning is located northeast of the city of Salem, Oregon, near the rural unincorporated community of Colton. The nearest small town is Estacada. The orchard is in Clackamas County, the region of influence (ROI) for this analysis. Clackamas County is also part of the Portland-Vancouver, OR-WA Primary Metropolitan Statistical Area (MSA)[3].

3.10.1 Community and Population

Clackamas County is a large county in area, containing over a dozen municipalities ranging in population from a few hundred to 30,000, as well as the mostly suburban and rural areas surrounding those towns. Approximately 52% of the county's population of 338,391 resides in these towns, with the remaining 48% in unincorporated areas (OED 2002). The area immediately adjacent to the seed orchard is rural in character, as discussed in Section 3.5.

Clackamas County is the third-most populous county in Oregon, representing 10% of Oregon's population of 3,429,399. The county's population increased by 21% during the 1990s. Population growth was somewhat slower during the 1980s, with an increase of 16% (USBC 2002a, USBC 2002c, OED 2002).

[3]An MSA is a region having a high degree of economic interdependence, with geographically integrated labor, retail, and housing markets. Such regions generally consist of a central city or several cities and the surrounding communities or counties.

The state population grew by 21% between 1990 and 2000, but had increased by only 8% during the 1980s. The population of Molalla in 2000 was 5,647 (USBC 2002a).

3.10.2 Economic and Income Characteristics

Clackamas County had a labor force of 188,280 in 2000, a 43% increase over 1990 employment, which in turn had increased by less than 5% between 1980 and 1990. The county's employment represents about 9% of the state's total. As of 2000, Clackamas County had a diversified economy, with nearly one-third of employment in the services sector, about one-fourth in wholesale and retail trade, and 10% in manufacturing. The financial, insurance, and real estate sector and construction were the other major non-governmental employment sectors, accounting for 10% and 7% of jobs, respectively. Government provided 9% of all county jobs, with local government accounting for about three-fourths of the government jobs. Federal civilian employment constitutes nearly 12% of government jobs and 1% of all jobs in Clackamas County. Farm employment and the agricultural, forestry, and fisheries sector together provide 6.1% of the county's employment, nearly double the proportion of employment for the U.S. as a whole (BEA 2002).

In 2000, the unemployment rate in Clackamas County was only 3.2%, compared to 7.5% for the MSA as a whole, 4.8% for Oregon, and 4.0% for the U.S. The July 2001 unemployment rate was 6.1% for the Portland MSA, 6.2% for Oregon, and 4.7% for the U.S. (OED 2002, OLMIS 2002).

Total personal income (TPI) for 2000 in Clackamas County was $11 billion. Per capita income (PCI), which is calculated by dividing an area's TPI by its total population, is used to compare income across regions. The 2000 PCI in Clackamas County was $34,525, which was 117% of the U.S. PCI of $29,469, and 125% of Oregon's PCI of $27,660 (BEA 2002).

Horning has an annual budget of between $679,000 and $855,000, approximately two-thirds of which is spent for payroll for its 11 full-time, one part-time, and two seasonal employees. At least six volunteer workers also contribute to the orchard's production efforts. The estimated annual value of plant materials products and related services exceeds $1,640,000. Cooperative agreements to provide seed to other agencies and private sector consumers are expected to yield at least $20,000 in fiscal year 2003, with increases anticipated in future years. Grants for native plant material production totaled more than $81,000 in fiscal year (FY) 2002 and $89,000 in FY2003. In addition, BLM and other agencies contribute funding specifically for the production of a variety of small, very specialized lots of native plant materials. Approximately $35,000 is spent annually for various types of pest control.

3.10.3 Environmental Justice

Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, was signed by the President on February 19, 1994. Environmental Justice has been defined by the EPA's Office of Environmental Justice as follows (EPA 1998):

> The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, local, and tribal programs and policies.

The environmental justice EO requires that each Federal agency identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. Environmental justice also takes into consideration EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, which was signed by the President on April 21, 1997. This EO requires that each Federal agency identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on children, who are more at risk because of developing body systems, comparatively higher consumption-to-weight ratios, behaviors that may expose them to more risks and hazards than adults, and less ability than adults to protect themselves from harm.

The environmental justice ROI, Clackamas County, is the same as for socioeconomic resources. To evaluate these potential effects, this section describes the minority and low-income characteristics of the ROI, based on data from the 2000 Census of Population and Housing. Demographic data regarding children are presented in Table 3.6-1.

The terms "low-income" and "minority" are defined according to guidance published by CEQ in 1997 and adopted by EPA. Under this guidance, "low-income" is defined as persons below the poverty level. The poverty threshold, which is a function of family size and is adjusted over time to account for inflation, was designated by the Federal government as $17,524 for a family of one adult and three children in 2000. "Minority" means persons designated in census data as Black (African-American), not of Hispanic origin; American Indian, Eskimo, or Aleut (Native American); Asian or Pacific Islander; or of Hispanic origin (CEQ 1997). According to the USBC definition, the Hispanic origin designation is separate from the ethnic (racial) designation, as people who identify their origin as Spanish, Hispanic, or Latino may be of any race (USBC 2001). Minority populations should be identified for environmental justice consideration where the minority population of the affected area exceeds 50% of the total population or is "meaningfully greater" than the minority population percentage in the general population of the assessment area (CEQ 1997). Table 3.10-1 presents ethnic data for census blocks containing and adjacent to Horning, Clackamas County, and comparison areas.

According to the 2000 census, the area surrounding Horning is overwhelmingly white and non-Hispanic, with only 6 persons (less than 2%) in non-white ethnic categories. There were no Hispanics counted within the adjacent population.

The 2000 census found that only 6.6% of Clackamas County's population was below the poverty threshold, while 11.6% of the population of Oregon and 11.3% of the U.S. population fall into this category (USBC 2002a). Data on poverty status are not yet available at the census block level, but data for the two block groups containing the census blocks adjacent to the orchard indicate that 6.9 percent of the block groups' population[4] fall below the poverty threshold, reflecting a slightly higher rate of poverty than for the county as a whole (USBC 2002d).

There are few residences near the boundaries of Horning, and no disproportionate numbers of low-income or minority individuals are found there. The 2000 census found that the census blocks adjacent to Horning contained 12 young children (under five years) and 47 older children (aged 5 to 14) (USBC 2002a). Section 3.6 contains more detail on the age distribution of the local population.

[4] The population for Census Tract 241, Block Group 3, was omitted from this calculation, because the census blocks within this group that are adjacent to Horning have no population.

Table 3.10-1. Ethnic Characteristics of Adjacent Census Blocks and Comparison Areas

Characteristic	Adjacent Census Blocks[1]		Clackamas County		Oregon		U.S.	
	Number	%	Number	%	Number	%	Number	%
Total population	312	100	338,391	100	3,421,399	100	281,421,906	100
One race[2]	310	99.4	330,061	97.5	3,316,654	96.9	274,595,678	97.6
White	306	98.1	308,852	91.3	2,961,623	86.6	211,460,626	75.1
Black	0	0.0	2,233	0.7	55,662	1.6	34,658,190	12.3
Native American	1	0.3	2,416	0.7	45,211	1.3	2,475,956	0.9
Asian[3]	3	1.0	8,292	2.5	101,350	3.0	10,242,998	3.6
Native Hawaiian/PI[3]	0	0.0	569	0.2	7,976	0.2	398,835	0.1
Other[4]	0	0.0	7,699	2.3	144,832	4.2	15,359,073	5.5
Two or more races[4]	2	0.6	8,330	2.5	104,745	3.1	6,826,228	2.4
Hispanic	0	0.0	16,744	4.9	275,314	8.0	35,305,818	12.5

Source: USBC 2002a.
[1]Census Tract 236 (Blocks 2022, 2037, 2038, 2039, and 2040) and Census Tract 241 (Block 1000, 1013, and 3025).
[2]"Black" = Black or African American; "Native American" = Native American or Alaska Native; "Native Hawaiian/PI" = Native Hawaiian/Other Pacific Islander; "Other" = Some other race.
[3]The 2000 Census separated the Asian and Native Hawaiian/Other Pacific Islander categories; they were previously combined under one category and are addressed as such in the CEQ and EPA Guidance.
[4]The 1997 CEQ Guidance did not address the new census categories "other" and "two or more races" for this analysis; those categories are also considered as minorities.

4.0 Environmental Consequences

Chapter 3 introduced and described the resources that could be affected by implementing the proposed action or an alternative; Chapter 4 assesses the potential impacts. As defined in 40 CFR 1508.14, the human environment includes natural and physical resources, and the relationship of people with those resources. Accordingly, this analysis has focused on identifying types of impacts and estimating their potential significance. Table 2.6-1 in Chapter 2 summarizes the potential environmental consequences of the proposed action and alternatives.

4.1 Introduction

This chapter is organized by resources, with information presented in the same sequence as in Chapter 3, providing a logical flow for analysis of potential environmental impacts. Section 2.6 identifies the specific resources that generated concern during scoping and EIS planning, and are therefore highlighted for the decisionmaker in that chapter.

Each resource-specific subsection provides (1) a summary of the potential impacts of implementing the proposed action or an alternative; (2) the analysis methods and significance criteria for determining significance, as defined in 40 CFR 1508.27; and (3) a discussion of the potential impacts of the proposed action and each alternative. The chapter concludes with an evaluation of cumulative impacts, discussion of potential mitigation measures, a discussion of unavoidable adverse impacts, an evaluation of the relationships between short-term uses of the environment versus long-term productivity, and a summary of irreversible and irretrievable commitments of resources.

The concept of "significance" used in this assessment considers both the context and the intensity or severity of the impact, as defined by 40 CFR 1508.27. The criteria used to characterize impacts are introduced at the beginning of each resource section. Significant impacts are effects that are most substantial and should receive the greatest attention in decision-making. Impacts described as minimal are identifiable and may be present, but the intensity or severity is below any threshold of concern, based on the criteria described in the specific resource discussion. Insignificant impacts result in little or no effect to the environment and cannot be easily detected; such impacts may also be referred to as negligible. If a resource would not be affected by a proposed activity, a conclusion of no impact was stated.

Impacts Common to All Alternatives

Under all alternatives, management actions not directly related to IPM, described in Section 2.1.2, would continue. These activities include administrative actions, such as facilities and equipment maintenance, which are comparable to the administrative actions described in the Salem District RMP (ROD-Administrative Actions). Orchard establishment and maintenance and buffer zone management are comparable to the silvicultural and harvest practices described for management of young stands described in the Salem District RMP. The impacts of these actions at Horning would be similar to the impacts described in Chapter 4 of the Final EIS for the Salem District RMP.

4.2 Air Quality

There would be insignificant impacts on air quality at and around Horning from vehicle emissions, from prescribed burns, and temporary very localized drift from pesticide applications. The seed orchard is located in an attainment area for all criteria pollutants, and emissions from proposed activities would not affect nearby non-attainment areas

in the Portland metropolitan area. Air quality impacts under any alternative would be insignificant. The no action alternative would not change existing air quality at the seed orchard.

4.2.1 Analysis Approach and Assumptions

The analysis was based on a review of existing air quality in the region, information on Horning's air emission sources, projections of emissions from the proposed IPM implementation, a review of Federal regulations, and the use of air emission factors from EPA. Current emissions were estimated using the latest available information on the types of equipment used at the seed orchard.

The significance of air quality impacts is based on Federal, state, or local regulations or standards. A significant impact would be a violation of standards, or an exposure of sensitive receptors to excessive quantities of fugitive dust or smoke. A short-term impact that did not exceed standards would not be significant. A reduction in baseline emissions would improve air quality. No standards have been established for aerial concentrations of pesticides.

4.2.2 Potential Impacts of Alternative A—Maximum Production IPM

Small increases in equipment use, and occasional helicopter flights, would minimally increase mobile source emissions. The number of vehicles and the amount of equipment would not substantially differ from existing usage at the orchard. Emissions generated from these activities would be slight, would not exceed ambient air quality standards, and would not be significant. Helicopter flights are anticipated only once or twice a year, and their emissions would be negligible. Manual or mechanical IPM methods could produce small, localized amounts of fugitive dust, but impacts would be insignificant.

One IPM method proposed for use at Horning is prescribed fire, which would generate particulate matter, volatile organic compounds, nitrogen oxides, and CO. To minimize the effects of these emissions, Horning would comply with local smoke management restrictions, which coordinate burns within a region to reduce cumulative impacts. To further reduce impacts, Horning would also manage the timing, vegetation type, size of burned area, fuel arrangements and moisture, ignition techniques, and patterns of prescribed burns, while taking into account weather conditions. Prescribed fire at Horning is used only infrequently, on small native plant plots and occasionally to burn diseased trees (see Section 2.2.2.3). Air quality impacts would be insignificant. Impacts to human health from prescribed fire are discussed in Section 4.6.2.3.

Aerial, ground vehicle, and hand methods of pesticide applications could result in spray drift and volatilized chemicals. The recently conducted risk assessment (summarized in Appendix C) found soil deposition of pesticides no further than 300 feet from the orchard boundary. Options for reducing drift include using spray equipment designed to produce 200- to 800-μm-diameter particles, since particles of 100 μm or less are more likely to drift farther, and prohibiting spraying when the wind speed exceeds 6 miles per hour or is blowing toward a sensitive receptor (for example, the organic farm located northeast of the seed orchard) or a nearby residence, or during an inversion. With the use of protection measures, which are an inherent part of all alternatives and are described in Section 2.3.1, impacts to air quality would be insignificant.

No other activities associated with this alternative would affect air quality.

4.2.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Under the proposed action, the more restricted application procedures (see Section 2.3.3) would further reduce the risk of pesticide drift to neighboring land parcels, including the organic farm. Impacts from mechanical and manual methods, and from prescribed fire, would be the same as those described under Alternative A. Impacts to air quality would be insignificant.

4.2.4 Potential Impacts of Alternative C—Ground-Based IPM

Under Alternative C, impacts would be similar to those described under Alternative B. Impacts to air quality would be insignificant. Although it is often assumed to be otherwise, aerial application of pesticides can be associated with decreased drift compared to some ground-based methods. The risk assessment predicted that aerial pesticide application, conducted as proposed by the seed orchard, would be associated with less drift potential than ground-based airblast sprayer application. Therefore, the potential risk of drift from application of esfenvalerate, while still below the threshold of significance for air quality impacts, would be slightly increased compared to Alternative B. Risks from biological, cultural, and prescribed fire methods would the same as for Alternative B.

4.2.5 Potential Impacts of Alternative D—Non-Pesticide Pest Management

Under Alternative D, no biological or chemical pesticides would be used, so there would be no possibility of pesticide drift. Impacts from mechanical and manual methods, and from prescribed fire, would be similar to those described under Alternatives A, B, and C. Impacts to air quality would be insignificant.

4.2.6 Potential Impacts of Alternative E—No Action: Continue Current Management Approach

Under Alternative E, the current insignificant air quality impacts would continue. Before BLM undertook a pesticide application, an EA would be prepared to determine potential impacts of that application. That EA would include an assessment of air quality impacts.

4.3 Geological Resources

No significant impacts to geological resources or soil are expected from the proposed action or alternatives.

4.3.1 Analysis Approach and Assumptions

Potential impacts were assessed by evaluating current conditions at the orchard (including geology, topography, soil types and properties, and hydrology) and components of the various alternatives to predict conditions occurring after implementation of these alternatives.

4.3.2 Potential Impacts of Alternative A—Maximum Production IPM

Impacts from pesticides and fertilizers applied to specified areas at Horning could be either impacts to the soils directly, or impacts where soils provide a pathway of potential contamination to another medium, such as water. Impacts to soils could occur through chemical changes to the soil, or physical changes (primarily compaction from heavy machinery). Chemicals could leach through the soil into the groundwater or run off to adjacent streams. Impacts where soil provides a pathway to another medium are evaluated in the respective sections of this chapter that address the affected resources (such as water quality or human health). Section 3.0 of the risk assessment (summarized in Appendix C) provides a detailed description of the potential for chemical transport through and on the soil, which can result in leaching or runoff of pesticides and fertilizers, leading to impacts on other resources.

Erosion Potential

All of the perennial streams at Horning are surrounded by vegetative buffers between the stream and orchard production units, consisting of mature hardwoods, conifers, and understory. Most of these buffers are about 50 to 100 feet or more in width. These buffers would be maintained, with only spot treatments for noxious weeds; therefore, no increase in erosion potential due to de-vegetation is expected from any of the control methods-

Impacts from Chemical Pesticides and Fertilizers

Impacts from the application of pesticides and fertilizers to soil can be divided into two groups – those occurring from chemicals which are highly mobile in soils and have a high water solubility, and impacts from chemicals with a low mobility in soil (high adsorption rate) and are only slightly soluble in water. Six of the pesticides proposed for application at Horning are highly mobile in soil – acephate, dimethoate, dicamba, hexazinone, picloram, and triclopyr. The risk assessment predicted that five of these (acephate, diazinon, dimethoate, hexazinone, and picloram) and ethylbenzene contained in the permethrin formulation would leach to the groundwater. The depth to bedrock varies from 20 to 40 inches in the Springwater soils, but is 60 inches or more in the Jory soils. The root zone extends to the bedrock in the Springwater soils; any leaching past this zone would reach the underlying bedrock. The application of the pesticides would not use a sufficient amount of water to move chemicals past the surface of the soil. (At a rate of 50 to 150 gallons per acre of water mixed with the chemical, this would be equivalent to about 0.02 to 0.05 inches of water applied to the area.) Any applied pesticides would likely remain near the surface and begin degrading, until subsequent rainfall or irrigation would move any remaining residues into the soil horizon. Mobile pesticides leaching through the soil column would not persist in the soil or bedrock, but would disperse and degrade to lower concentrations. Any impacts to geologic layers below the soils would be insignificant.

The remaining chemicals proposed for application have a low mobility in soil due to a higher rate of adsorption. These chemicals would likely remain near the surface of the soil and degrade over time. Most degradation occurs by microbial metabolism. Other methods of degradation include hydrolysis (the splitting of a molecule by the addition of the elements of water), photolysis (degradation by radiant energy), and chemical degradation. Except for two herbicides (hexazinone and picloram) with soil half-lives in the five to six month range, the soil half-life of most of these chemicals is less than three months. The fate and transport modeling conducted for the risk assessment (Section 3.0 of the risk assessment report) indicated that negligible accumulation was expected.

Impacts to the soils from the application of fertilizers would be insignificant. Nitrate and other components of the fertilizers remaining in the soil would be absorbed by plants over time.

Use of vehicles to apply pesticides or fertilizers could also contribute to soil compaction.

Impacts from Biological Controls

Impacts from control methods using sheep or goats to graze areas to control unwanted vegetation would be insignificant. Negligible amounts of compaction or erosion could occur, but would not substantially impact soils.

Impacts from Prescribed Fire

Prescribed fire would be utilized in small areas to remove unwanted vegetation in native plant beds, and to burn cut or cleared vegetation, insect-damaged branches and trees, insect-damaged cones, cones not harvested for seed production, and branches and trees affected by disease. The prescribed fires are anticipated to remove much of the vegetation and organic layers on top of the soils. This would increase potential runoff and the potential for soil erosion in these localized areas. The amount of vegetation and debris left after the fires depends on the intensity and duration of the fire. A low- to medium-intensity prescribed fire would generally not burn much of the organic layer of the soil. Most of the vegetation is well adapted to fire and would recover quickly, limiting the amount of potential erosion. Other impacts to the soil include reduced porosity of the soil from fine ash particles clogging the pore spaces of the soil and, depending on the intensity of the fire, a physical or chemical crust near the upper surface of the soil. With low- to medium-intensity fires in limited areas, the short-term impacts to soils would not be significant. Erosion would be more likely to occur in areas of steeper slopes, but litter and debris remaining after the prescribed fire would somewhat reduce potential erosion. The dense root system of existing plant communities would also limit soil erosion. Areas burned would not be sufficiently large to generate substantial erosion. Any erosion occurring would not likely be transported more than a few feet and would not cause siltation of streams.

Impacts from Cultural Controls

Soil would be compacted by machinery during mowing. The degree of compaction would depend on soil moisture conditions. All of the soils at Horning are vulnerable to compaction when the soil is wet. Compaction of soil would increase the amount of runoff and the potential for erosion.

4.3.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Impacts on soil and geologic resources from this alternative would not be significantly different than under Alternative A. Limitations on pesticide use could decrease the potential for impacts to soil chemistry from pesticide residues retained in the soil horizon. Impacts to soils from biological controls and prescribed fires would be the same as under Alternative A. Impacts to geological resources and soils occurring from implementation of Alternative B would be insignificant.

4.3.4 Potential Impacts of Alternative C—Ground-Based IPM

Impacts to soils from this alternative would be similar to those described under Alternative B, with one exception. There would be a slightly higher potential for soil compaction due to a greater likelihood of using heavy vehicles to apply esfenvalerate to a given orchard unit.

4.3.5 Potential Impacts of Alternative D—Non-Pesticide Pest Management

Impacts to soil chemistry from pesticide residues would not be an issue under this alternative. As under Alternative A, impacts to the soils from the application of fertilizers would be insignificant. Depending on the frequency and timing of mechanical, hand, and cultural methods of controlling pests, soil compaction could be somewhat greater compared to Alternatives A, B, or C.

4.3.6 Potential Impacts of Alternative E—No Action: Continue Current Management Approach

Use of non-pesticide methods would continue under this alternative, with no projected change in impacts from biological, cultural, or prescribed fire control methods. Potential soil impacts from chemical methods of control would be reviewed on a case-by-case basis if pesticide chemicals were proposed for use.

4.4 Water Resources

The primary water resource concern relating to the proposed IPM activities at Horning is how pest control methods, particularly the use of pesticides, would affect the surface water and groundwater as a result of pesticide transport and storage, as well as the associated potential exposures to downstream water users (primarily drinking water) and aquatic ecosystems.

Potential effects to water resources of most non-accident pesticide uses are expected to be minimal to negligible, based on the conclusions of the risk assessment (summarized in Appendix C). However, there could be risks from an accidental spill of pesticides directly into a tributary to either Nate or Swagger Creek. Protection measures incorporated into all of the alternatives are expected to minimize the potential water quality impact from runoff and spills. These measures are listed in Section 2.3.1. All of the alternatives include monitoring the use and effectiveness of these measures, and adjusting application procedures based on monitoring results.

The risk assessment estimated pesticide and fertilizer concentrations in surface water and ground water; see Tables C-1 to C-3 in Appendix C. The potential impacts of surface water and groundwater contamination to human health, such as from the ingestion of drinking water or contaminated fish, are addressed in Section 4.6 (Human Health and Safety). Potential impacts to the aquatic ecosystem, including special status species, are addressed in Section 4.7 (Biological Resources). Because of the drainage patterns and natural headwater topography of the orchard, developed floodplains are not present and therefore would not be affected by the proposed IPM activities. Floodplains are not discussed further in this section.

4.4.1 Analysis Approach and Assumptions

The major public scoping concern regarding water quality is the potential for pesticide contamination. Computerized fate and transport modeling was conducted to estimate concentrations of pesticides in the surface water and groundwater. The Groundwater Loading Effects of Agricultural Management System (GLEAMS) model, which models pesticide behavior in soils and water, was used to characterize the leaching and runoff behavior of the pesticides. This model used the best available data for orchard soil, watershed, and pesticide-use characteristics. Section 3.2.1 of the risk assessment report

provides a detailed description of the model, input parameters, and assumptions. In summary, there are four major components to GLEAMS: hydrology, erosion, nutrients, and pesticides. Factors considered included:

- Soil organic matter content and pH;
- Soil porosity and water retention characteristics;
- Pesticide decomposition rates and tendencies to be adsorbed;
- Pesticide solubility and vapor pressure;
- Pesticide application rates, methods, and timing;
- Surface and subsurface hydrological characteristics; and
- Local precipitation, irrigation practices, and climatic conditions.

To further distinguish the typical and maximum scenarios beyond any application rate and frequency differences listed in Table 2.2-1, the results of GLEAMS were handled as follows: In the typical scenarios, the mean of the 10 highest runoff concentrations over the modeling period was selected for use in the risk assessment. In the maximum scenarios, the single highest runoff concentration was used in the risk assessment.

The GLEAMS model predicted runoff of chemicals and water as they might be measured at the edge of each orchard unit. The Horning seed orchard units generally have significant areas of untreated field edges and well-vegetated buffers between treated acreage and receiving streams (between 50 and 100 feet). These untreated intervening areas (collectively termed "buffer zones") play a major role in reducing the amount of chemicals that actually reaches stream water. The seed trees and well-managed surface vegetation present at the orchard make it more similar to a well-managed forest and, although runoff does reach streams, it is mostly via subsurface shallow flow. In addition, both the climate, which is characterized by fairly even precipitation, and surface conditions at the seed orchard are conducive to percolation rather than direct runoff of rainfall. The limited amounts of irrigation required also limit contributions to runoff. As a result, streamflow from the orchard area also is primarily due to subsurface flow.

To account for the attenuating affect of the buffer zones on runoff, the USGS Method of Characteristics model was used to estimate concentrations in groundwater, onsite streams in Sections 13 and 23, Swagger Creek, Nate Creek (at the first point where all orchard tributaries have joined in), Milk Creek, and Clear Creek. These values are presented in Table C-1 of Appendix C to this EIS, and can be considered to represent 24-hour average concentrations. For groundwater, the GLEAMS simulations estimated the mass per unit area of each chemical leaching below the rooting zone. Estimated groundwater concentrations are presented in Table C-2 in Appendix C.

Finally, the Exposure Analysis Modeling System (EXAMS) model was used to predict downstream concentrations in Swagger Creek and Nate Creek if an accidental spill of pesticide concentrate or tank mix were to occur. Estimated concentrations in groundwater in the vicinity of the domestic well near the Horning orchard office also were estimated. Five potential spill sites were considered in the risk assessment.

4.4.2 Potential Impacts of Alternative A—Maximum Production IPM

4.4.2.1 Groundwater

Chemical contamination of groundwater would depend on the extent to which pesticides and fertilizers may leach through the soils into the groundwater and the depth of the water table. The extent of leaching would, in turn, depend on the physical properties of the soils affected (permeability, organic matter, percent clay, depth of soil horizons, and properties of geological materials underlying the soils) and the chemical properties of

the pesticide or fertilizer (primarily its water solubility and partition coefficient – ratio of chemical absorbed to the soil to the amount in soil solution).

In the typical and maximum scenarios (see Section 4.6.1 for descriptions of scenarios), several pesticides and other ingredients were seen to leach below the rooting zone: acephate, diazinon, dimethoate, hexazinone, triclopyr, and picloram, as well as ethylbenzene in permethrin. Even in the maximum scenarios, the estimated groundwater concentrations of pesticides at Horning are below levels that would be associated with any risks to human health (see Table 6-1 of the risk assessment report), and movement of groundwater away from the orchard units would lead to even lower concentrations, due to dispersion, adsorption, and degradation. Therefore, impacts to groundwater would be negligible.

The risk assessment predicted that nitrate from the application of ammonium phosphate-sulfate and calcium nitrate fertilizers would leach to the groundwater. Estimated concentrations in the groundwater were about 0.8 mg/L nitrate from ammonium phosphate-sulfate, 1.0 mg/L nitrate from calcium nitrate, and 0.01 mg/L phosphate. Impacts to the groundwater would be negligible, however, particularly given reduced concentrations in groundwater as it moves offsite away from the orchard units and becomes further diluted. No human health risks were associated with these concentrations for exposure through drinking water (see Section 4.6 and Appendix C).

Impacts to groundwater (specifically, drinking water) from an accidental spill of a container of pesticide concentrate at the mixing area are addressed in Section 4.6.

All of the alternatives would include an on-site water quality monitoring program. Groundwater from nearby orchard domestic wells would be monitored in the event of a spill to identify any groundwater contamination and the resulting pesticide concentration(s). Periodic monitoring of the shallow groundwater wells located in the greenhouse effluent field also would be conducted to identify concentrations of any greenhouse effluent pesticides in the local groundwater. Detailed information on the proposed Water Quality Monitoring Plan for Horning is found in Appendix B.

Biological and cultural control methods, such as mechanical methods, include no activities that would adversely affect groundwater. *B.t.*, a biological insecticide, is a naturally occurring soil bacteria. Applications of *B.t.* formulations do not increase levels of *B.t.* in soil. *B.t.* spores and crystals persist for a relatively short time. Like all soil microbes, *B.t.* does not percolate through the soil and its presence is confined to the top 10 inches of soil. Thus no groundwater contamination concerns are present (EPA 1998a).

4.4.2.2 Surface Water

Surface water contamination could potentially occur from the use of chemical pesticides or fertilizers and, to a lesser extent, from implementing biological and cultural IPM methods and prescribed fire. Each of these is discussed below. Potential impacts from pesticide and fertilizer use were analyzed for both normal applications and accidental spills.

Impacts from Pesticide and Fertilizer Applications

Surface water contamination could occur indirectly from runoff (overland flow) of pesticides or fertilizers after application. This occurrence would depend largely on the characteristics of the soil, including the amount of vegetation present, the slope of the affected area, and the chemical applied. For example, if a chemical adsorbs well to the soil, it will tend to stay in the soil and be broken down in place. A chemical that does not adsorb to the soil could be washed away via soil surface or subsurface movement with irrigation or rainwater, and would more likely be a potential contaminant. In general,

the risk assessment predicted negligible surface runoff losses of pesticides and fertilizers at the orchard (see Table C-1 in Appendix C). The primary reasons for negligible runoff, as mentioned previously, include the extensive buffer zones between treated acreage and receiving streams which significantly reduce the amount of chemicals that actually reach stream water. Timing of chemical applications in relation to rainfall and irrigation is also important. Longer time periods between irrigation and pesticide applications reduce the concentrations of the pesticide in the water, because of pesticide degradation. Some runoff would reach streams by interflow (flow just beneath the surface) where slope is sufficient.

Any chemical concentrations in runoff to Milk Creek are likely to be less than those predicted in the risk assessment. The risk assessment assumed that any chemical in runoff to Stream 8, in the southwest portion of Section 23, could enter Milk Creek (see Figure 3.4-2 for location of Stream 8). Stream 8 is ephemeral north of Unger Road (see Figure 2.1-1 for location of Unger Road); however, this flow goes underground before reaching the road. Flow resurfaces near the BLM property line. There is no direct surface connection between Streams 8d and 8e and Milk Creek.

The risk assessment predicted about 0.001 $\mu g/L$ of chlorpyrifos, and lower concentrations of other pesticides and fertilizers, would reach Section 13 streams in a typical use scenario. In Section 23, the predicted concentration of chlorpyrifos was 0.002 $\mu g/L$. The risk assessment predicted a concentration of 0.07 $\mu g/L$ of dimethoate, and lower concentrations of other pesticides and fertilizers, would reach Section 13 streams in a maximum use scenario. In the maximum use scenario, a concentration of 0.05 $\mu g/L$ of diazinon, and lower concentrations of other chemicals, was predicted to reach Section 23 streams. No significant change in the potential for sediment delivery to surface water is expected as a result of vegetation control using chemical herbicides.

Measures are taken to ensure that no off-target drift occurs during pesticide application, including drift to surface water. Spray nozzles are specifically designed to minimize drift. Buffer strips around streams and restrictions on spraying based on wind speed also would reduce the chance of drift reaching sensitive areas, such as streams. Equipment washing would be conducted in designated areas where the wash water would not contaminate surface water or groundwater. Section 2.3.1 lists the protection measures inherent in the proposed action and all alternatives.

In addition to the risk assessment results, water quality monitoring has been conducted after past esfenvalerate use and determined that surface runoff from the orchard units was an insignificant pathway for pesticide transport. Three types of monitoring were performed at the orchard to better characterize the effects of the April 2002 orchard pesticide spraying, as well as provide a continued assessment of selected fields that were also spraying with esfenvalerate in 2001 (BLM 2001a). *Implementation monitoring* was intended to document the protective measures that were implemented to minimize potential impacts from the 2002 pesticide spray. *Effectiveness monitoring* documented the performance of the protective measures in keeping pesticides out of the aquatic system, and *validation monitoring* documented the water quantity and quality compared to runoff predictions and assumptions modeled by BLM in the 2001 spray project EA (BLM 2001b).

The seed orchard conducted water quality monitoring for esfenvalerate in Section 13 streams after a helicopter application in April 2002. The sequence of application included orchard units B-35, B-36, P-13, P-11, P-12, and P-10 in Section 13; and P-33 and P-30 in Section 23. The perennial flowing tributary to Swagger Creek (below Horning Reservoir) was crossed once in order to spray units B-35 and B-36. The monitoring procedures and results are described in detail in the monitoring report (BLM 2002). Implementation monitoring confirmed that all protective measures (61 in total) designed in the EA were completed. In general, the effectiveness monitoring results for drift revealed no detectible concentrations of esfenvalerate in the 24 hours following the spray project.

The results for spring runoff reflected no detectible concentrations at a detection limit of 0.02 µg/L (samples taken during two stormflow events following the application). Effectiveness monitoring for the fall/winter runoff periods also resulted in no detectable concentrations in streams. Finally, results of the validation monitoring of the GLEAMS model as conducted for the 2001 EA, showed a disparity between the prediction of runoff and pesticide loss and the amount actually measured from the edge of the plots. Measured values for surface runoff amount and pesticide loss were less than predicted by GLEAMS during this modeling exercise specific to BLM's preparation of that EA. The predicted model values have inherent uncertainty in terms of pesticide movement through subsurface pathways of preferential flow or macro pore movement of water. Through previous monitoring and observation, it is evident this lateral subsurface flow and tile drain flow are a significant component of water movement from the orchard units to the stream systems (BLM 2001a). Past monitoring and stream gauge records at Horning indicate that precipitation occurring during the spring and summer does not usually induce surface runoff, indicating that it is unlikely for pesticides to reach surface water via runoff during the most probable time of pesticide application.

Results have been used to develop recommendations for future monitoring at the site, which have been incorporated into Horning's currently proposed Monitoring Plan (Appendix B). Such monitoring would be conducted as part of the proposed IPM program to check for contamination and ensure protection. The proposed plan encompasses the same components as before: implementation monitoring to document that design features have actually been implemented; effectiveness monitoring to document how well the design features have performed in avoiding the introduction of pesticides to the surface and groundwater systems; validation monitoring which would use the effectiveness data to validate the water quality modeling; and, as a fourth component, compliance monitoring, to document domestic water quality and pesticide fate in terms of irrigation effluent.

Impacts from Accidental Chemical Spill

Chemical pesticide contamination of surface water could occur in the case of an accidental spill during pesticide transport or application.

The EXAMS modeling predicted that maximum residues from spills into the larger perennial streams or intermittent streams of significant flow would reach Swagger Creek or Nate Creek within an hour. In the event of an accidental spill, members of the public and workers may be exposed to greater amounts of a pesticide than from normal applications. These risks are discussed in Section 4.6.

Impacts from Biological and Cultural Methods

Potential effects to surface water resources from biological methods, such as livestock grazing and *B.t.* in field runoff, would be minimal. Livestock grazing has occurred in past years at Horning with no noted adverse impacts. *B.t.*, even if it reached the streams, is not known as an aquatic bacterium and is not expected to proliferate in aquatic habitats. It is also considered very non-toxic, especially when used only in terrestrial applications.

Potential effects to water resources from cultural methods, such as sedimentation, also would be minimal. While soil-disturbing operations and soil compaction caused by the use of heavy machinery can lead to increased runoff and stream sedimentation, very little sediment, or bacteria in the case of biological methods, is likely to reach the orchard's onsite streams due to the extensive buffers of untreated vegetation. During periods of heavy rain, there is some potential for sediment or bacteria residues to be released into the local streams; however, concentrations are still expected to be minimal.

Impacts from Prescribed Fire

Potential effects to water resources from prescribed fire would be minimal. Fire can remove the top vegetation and organic layers of soils, which could increase the potential for runoff and soil erosion (particularly in areas of steeper slope). However, any erosion would not likely be transported more than a few feet and is not expected to cause siltation of streams. Litter and debris remaining after the prescribed fire would serve to reduce potential erosion, as would the dense root system of existing plant communities. Finally, the burn areas would not be sufficiently large to generate substantial erosion.

4.4.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Impacts to surface water and groundwater would be the same under the proposed action as in Alternative A for biological and cultural control methods. Impacts to water resources from pesticide and fertilizer application would be less than those identified in Alternative A because limitations incorporated into project design would control the potential for runoff or drift (see Section 2.3.3).

4.4.4 Potential Impacts of Alternative C—Ground-Based IPM

Impacts from this alternative would be similar to those described under Alternative B, except there is a greater potential for drift from some broadcast ground methods, such as airblast sprayer, than from aerial application. However, the potential impacts to water resources from a slight increase in drift are still expected to be negligible.

4.4.5 Potential Impacts of Alternative D—Non-Pesticide Pest Management

Under this alternative, potential runoff and leaching of pesticides to water would not be a concern since no pesticides would be applied. Fertilizers could be present in runoff, with the same impacts as under Alternative A. Overall impacts would be less compared to Alternatives A, B, or C. Greater reliance on cultural and non-pesticide biological methods may result in slightly greater potential for runoff and sedimentation in streams. However, impacts would be negligible due to the extensive buffers of untreated vegetation.

4.4.6 Potential Impacts of Alternative E—No Action: Continue Current Management Approach

Use of non-pesticide methods would continue under this alternative, with no projected change in impacts. Any potential use of pesticide methods of control would require a separate NEPA review each time a specific use was proposed. Impacts would be similar to Alternatives A or B (depending on project-specific details), but may be slightly less since fewer chemicals would likely be applied in the orchard on an annual basis, given the schedule limitations, costs, and administrative demands of preparing EAs on a case-by-case basis.

4.5 Land Use

Land use impacts are related to changes in the productive use of land as the result of an action. Insignificant impacts on land use are projected for the proposed action and all alternatives.

4.5.1 Analysis Approach and Assumptions

The most recent information about surrounding land uses—including aerial photos, census data, and scoping comments—was used to determine current land uses and evaluate potential impacts. A significant impact to land use would be a permanent or long-term (several years) change in how a parcel could be used. Neither the proposed action nor any alternative includes activities that would change existing land use at the seed orchard or neighboring parcels directly.

The potential for indirect impacts, from off-site transport of chemicals, was evaluated by reviewing the conclusions of the risk assessment (summarized in Appendix C). The only area of potential impact identified was ineligibility of land to be used for organic farming, which could occur if deposition from offsite pesticide transport exceeded limits for organic agricultural production set by the U.S. or Oregon Departments of Agriculture. The neighboring land parcels include a certified organic farm growing herbs and mushrooms, located northeast of the seed orchard; see Figure 3.5-1. The individual impact to the organic farm would be significant if any resulting pesticide residues were sufficient to cause the farm to lose its organic certification and, consequently, its ability to certify and market its produce as organic.

4.5.2 Potential Impacts of All Alternatives

No direct land use impacts are predicted under any alternative.

The risk assessment predicted negligible pesticide drift to neighboring land parcels (shown in Figure 3.5-1) under Alternative A (Maximum Production IPM), which emphasizes aggressive pest management and has the highest potential for use of pesticide chemicals. The potential for indirect land use impacts from pesticide transport to neighboring land units is even smaller for Alternatives B, C, E, and D, with the probability for impact decreasing successively under each alternative in that order. Alternative B (IPM with Environmental Protection Emphasis, the proposed action), includes limitations (see Section 2.3.3) that would reduce the potential for offsite pesticide transport to neighboring land parcels, below the levels predicted for Alternative A. Under Alternative C (Ground-Based IPM), impacts on land use would be similar to those predicted for Alternative B, since drift and runoff can occur from ground-based as well as from aerial applications. Under Alternative E (No Action), the current practice of preparing a NEPA document prior to pesticide use would continue. Any potential impacts to land use from pest management under this alternative would be identified in each project-specific NEPA document. It is likely that potential impacts would be insignificant, similar to those from Alternatives A, B, or C, depending on the details of the pesticide application. Finally, under Alternative D (Non-Pesticide Pest Management), no biological or chemical pesticides would be used, so there would be no possibility of pesticide transport to nearby land parcels.

While the probability of pesticide drift contaminating adjacent parcels (including the organic farm) is extremely low, unforeseen weather conditions, coupled with a failure to quickly respond to adverse conditions by ceasing aerial or airblast sprayer applications, could increase the possibility of such an impact. However, the overall impact on land use would be insignificant to other landowners surrounding the orchard and to others in the region under any alternative.

Biological, cultural, and prescribed fire control methods under all alternatives would have insignificant land use impacts at Horning or to neighboring parcels.

4.6 Human Health and Safety

Human health impacts as a result of any of the pest control methods could include chemical toxicity as a result of exposure to chemical pesticides, injury during use of cultural methods, and injury or smoke exposure during use of prescribed fire. No health impacts were identified for biological control methods or fertilizers. A quantitative human health risk assessment evaluated the potential effects to members of the public and seed orchard workers from using chemical pesticides and fertilizers under Alternative A. No risks to members of the public were predicted for non-accident exposures, but some pesticides (diazinon, dimethoate, propiconazole, dicamba, hexazinone, and mancozeb) were predicted to present risks to some workers in certain situations. In response to these identified risks, Alternative B was designed, which incorporates limitations on chemical pesticide use that reduce these estimated workers risks to negligible levels. These limitations are also incorporated into Alternative C. Alternative D does not include the use of pesticides, and Alternative E would result in less frequent pesticide application.

No risks are predicted for members of the public from non-accident exposure to chemical pesticides under any of the alternatives. Under Alternatives A, B, C, and E, an accidental spill into a stream could result in surface water that would be unsafe for drinking or fishing. There are potential risks to workers from six of the proposed pesticides under Alternative A, and no predicted risks to workers from pesticides under Alternatives B, C, D, and E. Potential impacts on human health due to injury, heat, fire, and smoke are possible under all the alternatives, but the most likely of these impacts are temporary (muscle strain, eye and throat irritation due to smoke). These risks are slightly increased under Alternative E (no action), since less use would be made of pesticides, and increase further under Alternative D, since these methods would take the place of all pesticide use.

4.6.1 Analysis Approach and Assumptions

Risks from biological, cultural, and prescribed fire methods were evaluated qualitatively, based on potential types of injuries or health effects associated with the specific method, and the frequency of such injuries or effects at Horning in the past.

To assess risks from use of chemical pesticides and fertilizers proposed under Alternative A, a quantitative risk assessment was conducted that estimated the risks to members of the public and workers as a result of using the proposed pesticides and fertilizers at Horning. The supporting record for this EIS contains the full risk assessment; a summary is provided in Appendix C, including tables summarizing the modeling predictions for surface and groundwater concentrations and drift deposition. The human health risk assessment methodology is summarized briefly in the following paragraphs. Detailed information on inputs, methods, assumptions, and outputs can be found in Sections 4.0, 5.0, and 6.0 of the risk assessment report.

Computerized fate and transport modeling was conducted to estimate concentrations of pesticides and fertilizers in environmental media at the point of exposure. Section 4.4.1 describes the surface water and groundwater modeling. AgDRIFT was used to estimate off-target pesticide drift from aerial applications, airblast applications, and applications using a tractor-pulled rig with a boom. Field studies reported in the published literature provided the basis for estimates of drift from other ground-based pesticide application methods. Section 3.0 of the risk assessment report provides details of the models, their inputs, and the results obtained.

The risk assessment employed the three principal analytical elements that the National Research Council (1983) described and EPA (1989, 2000a) affirmed as necessary for

characterizing the potential adverse health effects of human exposures to existing or introduced hazards in the environment: hazard assessment, exposure assessment, and risk characterization.

The risk assessment addresses risks from fertilizers and 19 pesticide active ingredients[1], as well as "other" ingredients in the pesticide formulations, formerly termed "inert" ingredients.[2]

Human Health Hazard Assessment

Hazard assessment requires gathering information to determine the toxic properties of each chemical and its dose-response relationship. Human hazard levels are derived primarily from the results of laboratory studies on animals. Toxic effects were divided into two categories, with different analytical approaches used: noncarcinogenic effects (for example, toxicity to the liver or nervous system) and carcinogenicity. The goal of the hazard assessment is to identify acceptable doses for noncarcinogens, and identify the cancer potency of potential carcinogens.

For noncarcinogenic effects, it is generally assumed that there is a threshold level, and that doses lower than this threshold can be tolerated with little potential for adverse health effects. EPA has determined threshold doses for many chemicals; these are referred to as reference doses (RfDs). The oral RfD is an estimate of the highest possible daily oral dose of a chemical that will pose no appreciable risk of deleterious effects to a human during his or her lifetime. The uncertainty of the estimate usually spans about one order of magnitude. RfDs are expressed in units of milligrams of chemical per kilogram of body weight per day (mg/kg/day).

Data on carcinogenic potential were reviewed for each chemical. Acephate, permethrin, propargite, and thiophanate-methyl are considered possible human carcinogens; and chlorothalonil, mancozeb, and hexachlorobenzene (a contaminant in picloram) are considered to be probable human carcinogens. For these compounds, cancer slope factors that have been calculated by EPA or other appropriate sources are used in this risk assessment. The cancer slope factor of a chemical represents the probability that a 1-mg/kg/day chronic dose will result in formation of a tumor, and is expressed as a probability, in units of "per mg/kg/day" or $(mg/kg/day)^{-1}$.

The RfDs and cancer slope factors used in this risk assessment are summarized in Table 4.6-1.

Human Health Exposure Assessment

Exposure assessment involves estimating doses to persons potentially exposed to the pesticides or fertilizers. In the exposure assessment, dose estimates were made for typical, maximum, and accidental exposures. These exposures are defined as follows:

- *Typical:* For this risk assessment, the word "typical" refers to a level of exposure within a scenario, and does not indicate whether the scenario itself is likely to occur. Typical exposure reflects the average dose an individual may receive if all exposure conditions are met. Typical exposure assumptions include the application rate usually used at the seed orchard, usual number of applications per year, the average of the ten highest values for chemical concentrations predicted to be present in runoff over a 10-year period of annual typical applications, and other similar assumptions.

[1] The biological insecticide B.t. and Safer® Insecticidal Soap were not included in the quantitative risk assessment. Potential environmental impacts are evaluated separately for these two control methods. See discussion at the end of Section 4.6.1.
[2] The risk assessment evaluated the formulations that are expected to be used. It is possible that other formulations of the same active ingredients may be substituted at times. The risks from other formulations containing the same active ingredients would be similar to the risks predicted in the risk assessment.

Table 4.6-1. Toxicity Endpoints

Chemical	RfD (mg/kg/day)	Dermal Absorption (%)	Cancer Slope Factor (per mg/kg/day)
Acephate	0.004	0.4 (1-hr)	0.0087
Chlorothalonil	0.015	0.15	0.00766
Chlorpyrifos	0.0003	1.78 (4-hr)	NA[a]
Dazomet	0.016	10	NA
Formaldehyde	0.020[b]	NA	0.000013 per $\mu g/m^3$
MITC	0.00365[b]	NA	NA
Monomethylamine	6.4[b]	NA	NA
Carbon disulfide	0.7[b]	NA	NA
Diazinon	0.0002	2	NA
Dicamba	0.045	10	NA
Dimethoate	0.0005	11	NA
Esfenvalerate	0.02	3 (8-hr)	NA
Glyphosate	2	1.42 (24-hr)	NA
Hexazinone	0.05	1	NA
Horticultural oil	1	1	NA
Hydrogen dioxide	NA	NA	NA
Mancozeb	0.03	1	0.0601
Permethrin	0.05	1.7	0.016
Picloram	0.2	0.2	NA
Hexachlorobenzene	NA	23	1.7
Propargite	0.04	14.5 (8-hr)	0.201
Propiconazole	0.013	40 (10-hr)	NA
Thiophanate-methyl	0.08	0.5	0.0039
Triclopyr	0.5	1.65 (8-hr)	NA
Inert Ingredients			
Cyclohexanone	5	10	NA
Ethylbenzene	0.1	3.4 (4-hr)	NA
Light aromatic solvent naphtha	0.02	10	NA
Xylene	2	3.9 (4-hr)	NA
Nitrate	1.6	NA	NA

[a]NA = Not applicable
[b]Inhalation RfC, units are mg/m3

- *Maximum:* Maximum exposure defines the upper bound of credible doses that an individual may receive if all exposure conditions are met. Maximum exposure assumptions include the maximum application rate according to the label, maximum number of applications per year, the highest chemical concentration predicted to be present in runoff over a 10-year period of annual maximum applications, and other similar assumptions.

- *Accidental:* The possibility of error exists with all human activities. Therefore, it is possible that during seed orchard operations, accidents could expose individuals to unusually high levels of pesticides or fertilizers. To examine these potential health

effects, several accident scenarios were evaluated for health effects to members of the public and workers.

It is important to note that these exposure scenarios estimate risks from clearly defined types of exposure. If all the assumptions in an exposure scenario are not met, the dose would differ from that estimated here, or may not occur at all.

For members of the public, the exposure scenarios analyzed in this risk assessment consist of the following:

- Ingestion of groundwater.

- Ingestion of water from Swagger Creek east of Section 13 or Nate Creek west of Section 23. (These creeks are not known sources of drinking water; therefore, drinking water from their tributaries is even less likely and these risks were not quantified).

- Ingestion of fish from Swagger Creek east of Section 13 or Nate Creek west of Section 23.

- Ingestion of grouse or quail hunted on or near grounds.

- Ingestion of mushrooms with pesticide residues.

- Dermal exposure to insecticide/fungicide drift residues on vegetation, or herbicide treatment residues on vegetation, during recreational hiking/hunting/mushroom gathering on orchard grounds.

- Dermal exposure to residues on dogs following recreational use of site.

The categories of workers evaluated in this risk assessment for occupational exposure to pesticides are as follows:

- Helicopter pilot.
- Helicopter mixer/loader.
- High-pressure hydraulic sprayer mixer/loader/applicator.
- Hydraulic sprayer with hand-held wand mixer/loader/applicator.
- Tractor-pulled spray rig with boom mixer/loader/applicator.
- Backpack sprayer mixer/loader/applicator.
- Granular spreader loader/applicator.
- Hand pollinator.
- Hand sprayer mixer/loader/applicator in greenhouse.
- Chemigation mixer/loader in greenhouse.
- Weighing and monitoring personnel in greenhouse.

Several accidental exposure scenarios were also evaluated:

- Ingestion of groundwater after a spill of concentrate.
- Ingestion of fish and water containing runoff from a spill of concentrate.
- Ingestion of fish and water downstream of a spill of tank mix directly into a stream.
- Spill of pesticide concentrate onto worker's skin.
- Spill of pesticide mixture onto worker's skin.
- Spray of worker with tank mix of pesticide.

Human Health Risk Characterization

Characterizing risk that results from different levels of exposure illustrates a principal tenet of risk assessment, set down by Paracelsus in the 16th century:

> All substances are poisons; there is none which is not a poison. The right dose differentiates a poison from a remedy.

Toxicity is a chemical-specific property that does not vary based on the exposure situation; it is determined by a substance's ability to cause effects at certain doses. That is why the exposure analysis is required, to determine whether any exposures will occur at the levels associated with those effects: even a highly toxic chemical can be "safe" at very low levels of exposure, while a relatively nontoxic chemical can cause effects if the exposure is sufficiently high.

In this risk assessment, the potential noncarcinogenic risks were evaluated by comparing the representative doses (estimated in the exposure assessment) with the RfDs (identified in the hazard assessment). All the RfDs used in this risk analysis take into account multiple exposures over several years and represent acceptable dose levels. The comparison of dose to RfD consists of a simple ratio, called the hazard index:

$$\textit{Hazard Index} = \textit{Estimated Dose (mg/kg/day)} \div \textit{RfD (mg/kg/day)}$$

If the estimated dose does not exceed the RfD, the hazard index would be one or less, indicating the dose is within the range generally considered to pose no adverse effects to humans.

A dose estimate that exceeds the RfD, although not necessarily leading to the conclusion that there will be toxic effects, clearly indicates a potential risk for adverse health effects. Risk is presumed to exist if the hazard index is greater than one. However, comparing one-time or once-a-year doses (such as those experienced by the public or in an accident) to RfDs derived from long-term studies with daily dosing tends to exaggerate the risk from those infrequent events.

To estimate cancer risk, the dose is averaged over a lifetime (75 years), and multiplied by the chemical's cancer slope factor. The resulting cancer probability is compared to a benchmark value of one in one million, a value commonly accepted in the scientific community as representing a cancer risk that would result in a negligible addition to the background cancer risk of approximately one in four in the U.S.

Analysis of B.t., Imidacloprid, and Safer® Insecticidal Soap

B.t. is a rod-shaped bacterium that produces a protein (a delta endotoxin) that is toxic to insects. *B.t.* is a naturally occurring microorganism that is found in the soil. According to EPA, no known mammalian health effects have been demonstrated in any infectivity/pathogenicity study (EPA 1998a). Some strains of *B.t.* have the potential to produce various toxins that may exhibit toxic symptoms in mammals; however, the manufacturing process includes monitoring to prevent these toxins from appearing in products. In terms of risks to seed orchard application or re-entry workers, EPA stated that "the potential for eye, dermal, and inhalation exposure to mixers, loaders and applicators does exist. The label for *Bacillus thuningiensis* based products may recommend wearing gloves, goggles, and a dust mask or equivalent pulmonary tract covering. However, because of a lack of mammalian toxicity, the risk from occupational exposure is minimal." Seed orchard personnel would follow all label guidelines and recommendations to minimize occupational exposure, as with all other pesticides proposed for use in the IPM program. In terms of risk to members of the public, anyone contacting soil is likely to have been dermally exposed to naturally occurring *B.t.* (EPA

1998a). The mechanism of its pesticidal action is unique to the gut membrane of insects, with no equivalent or similar mechanism in humans or other mammals. Its 50-year use history in agricultural and community pest (mosquito, gypsy moth, other) control projects with no known adverse effects in members of the public (EPA 1998a) also supports the conclusion that there would be no significant impacts from seed orchard use.

Imidacloprid is a chloronicotinyl insecticide. It is proposed for use only in the form of the Imicide® product, a capsule implanted directly into a tree. Movement of imidacloprid is restricted to the vascular system of the tree; therefore, there is no potential for exposure to members of the public following application. Applicator exposure is highly unlikely due to the capsulized form of the product, but could occur in the accidental situation in which a capsule breaks open and a worker is dermally exposed to the contents. The label for conifer seed tree use of Imicide® states that the 3-mL size capsules would be used; each contains 332.1 mg a.i. (Mauget 2003). Assuming that 25% of the spilled amount remained on the skin, and using a dermal absorption factor of 7.2% (EPA 2003), a dose to a 71.8-kg adult would be 0.083 mg/kg. Comparing this to an acute RfD (appropriate for one-time accidental exposures) of 0.14 mg/kg (EPA 2003), the resulting hazard index is 0.60, indicating no risk to workers from this accident scenario. Imicide has demonstrated no evidence of carcinogenicity in studies in rats and mice (EPA 2003).

Safer® Insecticidal Soap contains potassium salts of fatty acids. Fatty acids are naturally occurring compounds. The safety of this class of compounds is exemplified by the fact that they are permitted for direct addition to food for human consumption by the U.S. Food and Drug Administration (21 CFR 172.863). They exhibit low acute toxicity by the oral route of exposure, but can be irritating to the skin or eyes (EPA 1992).

No significant health effects are expected for either workers or members of the public from seed orchard use of *B.t.*, Imicide®, or Safer® Insecticidal Soap.

Analysis of Hand-Held Wick and Injection Application of Glyphosate

Subsequent to the risk assessment, Horning proposed to include hand-held wick and injection applications of the Rodeo® formulation of glyphosate in the IPM program. These methods provide a more precise means to control individual undesirable plants, particularly when they are present in limited sensitive areas where direct application to each target plant is feasible, and offers the greatest protection against inadvertent transport of the chemical to soil, water, or other vegetation. The hazard index for application workers using a hand-held wick to apply glyphosate was estimated to be 2.62 x 10^{-4}, in both the typical and maximum scenarios, based on the application parameters listed in Table 2.2-1 and exposure studies reported by EPA (1998b). The hazard indices for application workers using direct plant injection to apply glyphosate were estimated to be 5.96 x 10^{-6} and 1.19 x 10^{-5} in the typical and maximum scenarios, respectively, based on the application parameters listed in Table 2.2-1 and exposure studies reported by EPA (1998b). There are no cancer risks from glyphosate. Therefore, no significant risks are predicted for workers from these additional application methods under any alternative in which they are included. No exposures (and therefore no risks) from these methds are expected for members of the public under any alternative.

Adjuvants and Surfactants

In some cases, surfactants or adjuvants may be added to formulated pesticide products to improve their effectiveness or minimize handling and application problems. The seed orchard will only use surfactants or adjuvants that do not contain any ingredients on EPA's List 1 or 2, where listing indicates a chemical is of toxicological concern, or is potentially toxic with a high priority for testing (EPA 2000b). If a surfactant or adjuvant

that contains any List 1 or 2 ingredients is considered, the risk associated with that chemical would be evaluated before a use determination is made.

4.6.2 Potential Impacts of Alternative A—Maximum Production IPM

4.6.2.1 Biological Control Methods

No significant impacts on human health are expected from the use of biological controls, including the use of the biological insecticide *B.t.*, cattle grazing to remove grass from orchard units, and the use of bird and bat boxes to attract insect-eaters.

4.6.2.2 Chemical Control Methods

The assumptions used in the risk assessment regarding application rates, frequency, and areas potentially treated correspond to the details of Alternative A. Hazard indices and cancer risks for each chemical and scenario are presented in tables in Section 6.0 of the risk assessment report. The chemicals and scenarios for which risks were identified are summarized in the following paragraphs and in Table 4.6-2.

Members of the Public

For members of the public, hazard indices were less than one for all typical and maximum exposure scenarios, and cancer risks were all less than 1×10^{-6} (one in one million), with non-zero cancer risks ranging up to 1.22×10^{-9} (1.22 in one billion). Therefore, no significant risks are predicted for members of the public.

Table 4.6-2. Summary of Scenarios with Predicted Human Health Risks Under Alternative A

Chemical	Scenario	Risk
Risks to Members of the Public		
None	None	None
Risks to Workers		
Diazinon	High-pressure hydraulic sprayer mixer/ loader/applicator	Hazard index = 1.17 (typical) and 5.84 (maximum)
	Hand pollinator (after spraying with high-pressure hydraulic sprayer)	Hazard index = 20.3 (maximum)
Dimethoate	High-pressure hydraulic sprayer mixer/ loader/applicator	Hazard index = 24.7 (typical) and 64.8 (maximum)
Mancozeb	Greenhouse weighing/monitoring personnel	Cancer risk = 5.15×10^{-6}
Dicamba	Backpack sprayer	Hazard index = 8.35 (typical) and 16.7 (maximum)
Hexazinone	Backpack sprayer along fencelines	Hazard index = 1.40 (typical) and 5.59 (maximum)

Workers

For typical scenarios, all worker hazard indices are less than one, with the following exceptions:

- A high-pressure hydraulic sprayer mixer/loader/applicator applying diazinon or dimethoate, and
- A backpack sprayer applying propiconazole, dicamba, or hexazinone.

In the maximum scenarios, the hazard indices exceed one for the following workers:

- A high-pressure hydraulic sprayer mixer/loader/applicator applying diazinon or dimethoate;
- A backpack sprayer applying dicamba or hexazinone; and
- A hand pollinator encountering residues of diazinon.

The estimated cancer risk to greenhouse weighing/monitoring personnel encountering residues of mancozeb is 5.15 in one million, exceeding the standard point of departure of one in one million. All other cancer risks to workers were less than one in one million.

Accidents

For a spill of a container of pesticide concentrate at the mixing area, no risks to the public from drinking groundwater contaminated by leached chemical were predicted. If precipitation caused runoff of spill residues to surface water from the spill site, risks were predicted from diazinon, dimethoate, permethrin, and chlorothalonil to adults and children consuming fish or surface water from Swagger Creek. All estimated cancer risks were less than one in one million.

For a spill of an application tankload of mixed pesticide into the onsite stream east of Horning Reservoir, risks to the public from drinking water and eating fish from Swagger Creek are predicted for acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, propargite, chlorothalonil, propiconazole, dicamba, hexazinone, picloram, and dazomet. Cancer risks from permethrin and propargite exceed one in one million.

For a spill of an application tankload of mixed pesticide into the onsite stream east of Orchard Unit B14, risks to the public from drinking water and eating fish from Swagger Creek are predicted for acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, propargite, chlorothalonil, propiconazole, dicamba, hexazinone, picloram, and dazomet. Cancer risks from permethrin and propargite exceed one in one million.

For a spill of an application tankload of mixed pesticide into the onsite stream west of Orchard Unit P67, risks to the public from drinking water and eating fish from Nate Creek are predicted for acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, propargite, chlorothalonil, propiconazole, dicamba, hexazinone, and dazomet. Cancer risks from permethrin and propargite exceed one in one million.

In the accident scenario in which a worker spills liquid pesticide concentrate on the skin, hazard indices exceed one (ranging up to 10,100 for dimethoate) for all liquid concentrates except horticultural oil, glyphosate, picloram, and triclopyr. Estimated cancer risks were all less than one in one million.

In the accident scenario in which a worker spills tank-mixed diluted pesticide on the skin, hazard indices are greater than one for chlorpyrifos, diazinon, dimethoate, and dicamba. All estimated cancer risks are less than one in one million.

Hazard indices for the accident scenario in which a worker was directly sprayed exceed one for chlorpyrifos, diazinon, and dimethoate. Estimated cancer risks are all less than one in one million.

4.6.2.3 Prescribed Fire

Potential impacts on human health from prescribed burning as a vegetation control measure were evaluated in the *Final EIS for Vegetation Management in 13 Western States* (BLM 1991). Possible effects are summarized as follows:

Risks from Fire

Prescribed burning presents various hazards to ground crews, who could possibly receive injuries ranging from minor burns to severe burns that may result in permanent tissue damage. However, standard safety procedures, protective gear, and training are integrated into every prescribed burn plan and are expected to reduce or eliminate most hazards. If a burn escapes and causes a wildfire, members of the public in adjacent areas may be endangered, and the potential is higher for severe worker injuries (both for orchard workers and firefighters responding to the incident).

Risks from Smoke

Substances that may be found in wood smoke include particulate matter, carbon dioxide, nitrogen oxides, aldehydes, and ketones. The proportion of each varies widely, depending on factors such as moisture content in the vegetation and the temperature of the fire.

Particulate matter is a result of incomplete fuel combustion. Fine particulate matter, with a diameter less than 2.5 μm, has a greater ability than do larger particles to avoid the body's defense mechanisms and reach the lungs. Carbon dioxide, nitrogen oxides, and other gaseous compounds of smoke generally decompose or diffuse into the atmosphere relatively quickly. However, some may attach to particulate matter and remain more concentrated and protected from decomposition. For example, aldehydes, which inhibit the removal of foreign material from the respiratory tract, may be adsorbed onto the surface of particles. Polynuclear aromatic hydrocarbons (PAHs) are of significant toxicological concern in evaluating the health effects of wood smoke. The PAHs in wood smoke contain at least five carcinogenic chemicals: benzo(a)pyrene, benzo(c)phenanthrene, perylene, benzo(g,h,i)perylene, and the benzofluoranthenes.

Exposures to the carcinogenic and possibly carcinogenic PAHs in wood smoke from burning vegetation were estimated for exposures to prescribed burns by BLM (1991). Estimated cancer risks were not expected to exceed the benchmark of 1 in 1 million for any member of the public or worker, even in extreme cases. Because smoke from prescribed fires will affect local air quality for a short time, sensitive individuals may experience eye, throat, or lung irritation from these exposures. Possible effects on workers with closer exposure may include eye irritation, coughing, and shortness of breath.

The effects (if any) on an individual from a prescribed fire or pile burn can vary greatly, and would depend on the size of the burn, the atmospheric conditions at the time of the burn, and the proximity of the individual.

4.6.2.4 Cultural Controls

Cultural controls include manual and mechanical methods of vegetation control, involving manual labor, and the use of hand tools and machinery. Examples of hand tools include hoes, rakes, and various types of pruners and cutters. Machinery includes

tractors, mowers, chainsaws, gasoline-powered string trimmers, and other equipment. Impacts on safety and health could include falls, sprains, and other accidental injuries; cuts caused by tools; injuries from accidental contact with equipment or its attachments (blades, mowers, plows); and the possible initiation or aggravation of chronic health problems such as tendon or ligament damage or arthritis. There is some risk to workers of falling or being hit by limbs or tree trunks when pruning orchard trees. When temperatures are high, workers may experience fatigue, heat exhaustion, or heat stroke. Individuals who are sensitive to irritants present in some materials (sawdust, mulch, irritating plant hairs, and spines), or who are severely allergic to insect bites or stings, may experience moderate to severe health effects if exposed to these irritants in the course of conducting cultural pest management activities. No risks to members of the public are expected from cultural control methods.

4.6.2.5 Other Control Methods

No risks to human health are expected from the use of pheromone bait traps or from potential public exposure to nitrates following fertilizer use, as modeled in the risk assessment (see Chapter 4.0 of the risk assessment report).

4.6.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Alternative B was designed in response to the results of the quantitative risk assessment, by incorporating limitations to specifically address any non-accident risks under Alternative A (which are summarized in Table 4.6-2). The risks from Alternative A (from Table 4.6-2) and the corresponding limitations that address the risks (from Section 2.3.3) are correlated in Table 4.6-3. With these risk-responsive limitations as part of Alternative B, no adverse effects to human health are expected from the use of chemical pesticides under this alternative, except if an accident were to occur. The risks from accidents are the same as those identified under Alternative A. Risks from biological, prescribed fire, cultural methods, and other methods of pest control are the same as under Alternative A.

4.6.4 Potential Impacts of Alternative C—Ground-Based IPM

Since no risks are predicted for workers or members of the public from aerial esfenvalerate application, the omission of that method from the alternative does not change the risks. The risks from Alternative C would be the same as from Alternative B: no risks to members of the public or workers from chemical pesticides except in the case of accidents. Risks from biological, prescribed fire, cultural methods, and other methods of pest control are the same as under Alternatives A and B.

4.6.5 Potential Impacts of Alternative D—Non-Pesticide Pest Management

Under Alternative D, the chance for injury would exist for workers from prescribed fire and cultural control methods. There would be no risks from pesticides since they would not be used.

4.6.6 Potential Impacts of Alternative E—No Action: Continue Current Management Approach

If BLM continued its current management approach, overall health risks would be intermediate between those of Alternative A and Alternative D. Pesticides would likely be used less frequently, due to the need to conduct individual NEPA analyses for each project. Therefore, the potential for risks from pesticides, including accidents, would

Table 4.6-3. Risk-Responsive Limitations to Protect Human Health Under Alternative B

Identified Risk from Alternative A			Alternative B Limitation that Addresses Risk
Chemical	Scenario	Individual	
Diazinon	High-pressure hydraulic sprayer	Mixer/loader/applicator	Would be applied to no more than 250 trees in one day at a maximum rate of 0.015 lb a.i. per tree (nor any combination of number of trees treated and application rate with a total amount of diazinon applied more than 3.75 lb a.i.) by any individual worker who is conducting both the mixing/loading and application activities.
		Hand pollinator	An individual conducting hand pollination activities would not work on trees that had been treated with diazinon until at least 11 days post-application.
Dimethoate	High-pressure hydraulic sprayer	Mixer/loader/applicator	Would be applied to no more than 22 trees in one day at a maximum rate of 0.13 lb a.i. per tree (nor any combination of number of trees treated and application rate with a total amount of dimethoate applied more than 2.86 lb a.i.) by an individual using the high-pressure hydraulic sprayer, and an individual other than the applicator would conduct the mixing/loading activities. If more than one applicator sprays trees during a single day, different mixer/loaders would prepare each pesticide mixture.
Mancozeb	Greenhouse use	Greenhouse weighing/monitoring personnel	The frequency of mancozeb use in the greenhouses will typically be only twice per year, with a maximum frequency of 10 times per year. Weighing and monitoring personnel will allow 24 hours to elapse before handling seedlings treated with mancozeb.
Dicamba	Backpack sprayer	Mixer/loader/applicator	An individual applying dicamba using a backpack sprayer would apply no more than 0.61 lb a.i. during any given day.
Hexazinone	Backpack sprayer along fencelines	Mixer/loader/applicator	An individual applying hexazinone using a backpack sprayer would apply no more than 6.5 lb a.i. during any given day.

be lower. There would be a risk of injury to workers from prescribed fire and cultural control methods.

4.7 Biological Resources

Risks to non-target species from biological, cultural, and prescribed fire methods were evaluated qualitatively. No impacts are expected from these pest control methods under any alternative.

A quantitative non-target species risk assessment evaluated the potential effects to terrestrial wildlife and aquatic species from using chemical pesticides and fertilizers under Alternative A. In most cases, little or no adverse impact to terrestrial wildlife populations is expected from the pesticides proposed for use at Horning under typical conditions of use, with the possible exception of impacts to bird and amphibian species from applications of three of the insecticides (chlorpyrifos, diazinon, and dimethoate). Most of the estimated wildlife exposures are extremely low, and are several orders of magnitude below the levels of concern. No acute lethal risks to aquatic species were

predicted for pesticides or fertilizers under Alternative A. An analysis of the potential for sublethal effects on special status fish species identified no risks in areas where they are present and there is a hydrologic connection to Horning.

In response to the risks identified for Alternative A, Alternative B was designed, which incorporates limitations on chemical pesticide use that reduce these estimated risks to negligible levels. These limitations are also incorporated into Alternative C. Alternative D does not include the use of pesticides, and Alternative E would result in less frequent pesticide application. Therefore, negligible risks from pesticides and fertilizers are expected from Alternatives B, C, and D, while risks from Alternative E would continue to be identified and evaluated on a project-by-project basis.

Under Alternatives A, B, C, and E, an accidental chemical spill could result in surface water concentrations that would be harmful to both terrestrial wildlife and aquatic species. Alternatives B and C incorporate limitations on routes for transporting chemical pesticides at Horning; therefore, the probability that such a spill would occur is decreased under these alternatives.

4.7.1 Analysis Approach and Assumptions

Risks from biological, prescribed fire, and cultural methods of pest control were evaluated qualitatively, based on the types of impacts possible.

4.7.1.1 Non-Target Species Risk Assessment

A quantitative non-target species risk assessment was conducted to evaluate the potential effects of the proposed chemical pesticides and fertilizers on terrestrial and aquatic wildlife species. The methodology is summarized briefly in the following paragraphs; detailed information on inputs and methodology can be found in Sections 7.0, 8.0, and 9.0 of the risk assessment report. Additional analysis was conducted for impacts to special status aquatic species that may be present at or near Horning; this is described in detail in Appendix D.

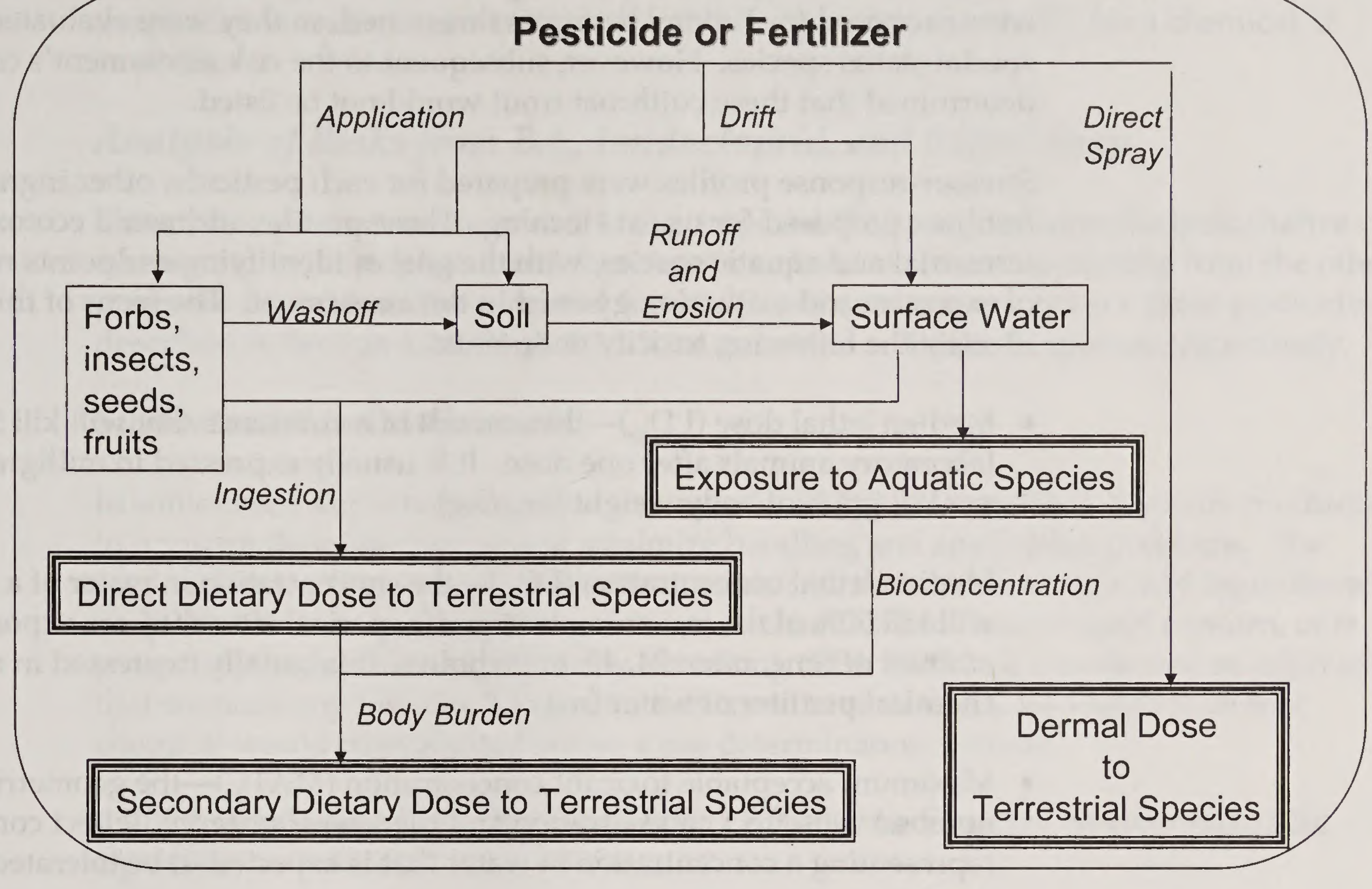
The non-target species risk assessment follows the steps of problem formulation, analysis, and risk characterization, as described in EPA's Guidelines for Ecological Risk Assessment (EPA 1998c). This risk assessment also identifies uncertainties that are associated with the conclusions of the risk characterization. Risks to non-target species were evaluated for the pesticides, fertilizers, and List 1 or 2 "other" ingredients in the pesticide formulations.[3] A conceptual model was developed to illustrate the relationships between stressors (pesticides or fertilizers), exposure routes, and receptors. The conceptual model is presented in Figure 4.7-1.

The representative terrestrial species evaluated in the risk assessment are listed below.

Mammals:
- Cow (domestic)
- Sheep (domestic)
- Coyote (carnivore)
- Jack rabbit (small herbivore)
- Long-eared myotis (insectivore)

[3] The risk assessment evaluated the formulations that are expected to be used. It is possible that other formulations of the same active ingredients may be substituted at times. The risks from other formulations containing the same active ingredients would be similar to the risks predicted in the risk assessment.

Figure 4.7-1. Conceptual Model



Birds:

- Black-capped chickadee (conifer seed-eater)
- California quail (game bird)
- Mallard duck (water fowl)
- Red-tailed hawk (raptor)
- Song sparrow (seed-eater)

Reptiles/amphibians:

- Pacific tree frog

These particular wildlife species were selected because they represent the majority of the species present, or the seed orchard has suitable habitat and is within their range (e.g., selection of black-capped chickadee as conifer seed-eater), and because they represent several types of coverage: a range of phylogenetic classes, body sizes, foraging habitat, and diets for which parameters are generally available. In addition, several special status terrestrial species were evaluated for potential risk:

- Western pond turtle
- Common nighthawk
- Oregon vesper sparrow
- Western meadowlark
- Streaked horned lark

Risks were also estimated for aquatic species for which ecotoxicity data are available: rainbow trout as a representative coldwater fish species, the water flea *Daphnia magna* as a representative aquatic invertebrate, and tadpoles of the Pacific tree frog as a representative amphibian aquatic stage. Risks were also evaluated for steelhead trout, a Federally listed threatened species and state-listed critical species that is present in Clear Creek and Milk Creek near Horning. At the time of the risk assessment, cutthroat trout were proposed for Federal listing as threatened, so they were evaluated as if they were a special status species. However, subsequent to the risk assessment's completion, it was determined that these cutthroat trout would not be listed.

Stressor-response profiles were prepared for each pesticide, other ingredient, and fertilizer proposed for use at Horning. These profiles addressed ecotoxicity to both terrestrial and aquatic species, with the goal of identifying endpoints relevant to the types of exposure and methodology used in the assessment. The focus of this research was to identify the following toxicity endpoints:

- Median lethal dose (LD_{50})—the amount of a substance that will kill 50% of a group of laboratory animals after one dose. It is usually expressed in milligrams of the chemical per kilogram of body weight (mg/kg).

- Median lethal concentration (LC_{50})—the concentration in water of a substance that will kill 50% of the test animals (aquatic species) after they are exposed for a specified amount of time, often 24, 48, or 96 hours. It is usually expressed in milligrams of chemical per liter of water (mg/L).

- Maximum acceptable toxicant concentration (MATC)—the geometric mean of the no-observed-effect concentration and the lowest-observed-effect concentration, representing a concentration in water that is expected to be tolerated by the test species.

The stressor-response profiles for all chemicals are presented in Section 8.3 of the risk assessment report.

Exposures to non-target species were modeled for both typical and maximum scenarios, as in the human health risk analysis summarized in Section 4.6. The results of computerized fate and transport modeling were used to estimate concentrations of chemicals at points of exposure for non-target species, and are included in Tables C-1 to C-3 in Appendix C. Details of the methods and models can be found in Sections 3.0 and 8.0 of the risk assessment report.

The risk assessment principle that "the dose makes the poison," discussed in Section 4.6.1 under "Human Health Risk Characterization," also applies to risk characterization for wildlife and aquatic species. Both chemical-specific toxicity and estimated levels of exposure must be considered before risk can be predicted.

By comparing the exposure profile data (estimated dose or water concentration) to the stressor-response profile data (LD_{50}s, LC_{50}s, MATCs), an estimate of the possibility of adverse effects can be made. The levels of concern are determined following the quotient methodology used by EPA's Office of Pesticide Programs. The quotient is the ratio of the exposure level to the hazard level. For acute exposures, the levels of concern at which a quotient is concluded to reflect risk to non-target species are as follows:

- Terrestrial species (general): 0.5, where dose equals one-half the LD_{50}.

- Terrestrial species (special status): 0.1, where dose equals one-tenth the LD_{50}.

- Aquatic species (general): 0.5, where water concentration equals one-half the LC_{50}.
- Aquatic species (special status): 0.05, where water concentration equals one-twentieth the LC_{50}.

Due to the high level of concern for protecting threatened salmonids in the watershed, the predicted water concentrations are also compared to the MATC for a chemical, if available.

Analysis of Risks from B.t., Imidacloprid, and Safer® Soap

These three products were added to the proposed IPM program after the quantitative risk assessment was completed, and therefore have been evaluated separately from the other proposed pesticides. The potential for non-target species impacts from these pesticides is described in Section 4.7.2.2 and 4.7.2.3 for terrestrial and aquatic species, respectively.

Surfactants and Adjuvants

In some cases, surfactants or adjuvants may be added to formulated pesticide products to improve their effectiveness or minimize handling and application problems. The seed orchard will only use surfactants or adjuvants that do not contain any ingredients on EPA's List 1 or 2, where listing indicates a chemical is of toxicological concern, or is potentially toxic with a high priority for testing (EPA 2000b). If a surfactant or adjuvant that contains any List 1 or 2 ingredients is considered, the risk associated with that chemical would be evaluated before a use determination is made.

4.7.1.2 Risk Analysis for Sublethal Effects to Special Status Aquatic Species

The non-target species risk assessment (summarized in Appendix C) evaluated the potential for lethal effects on fish from pesticides or fertilizers in surface runoff or from drift during application. For each chemical, the risk assessment identified the LC_{50} for the most sensitive coldwater species for which data were available. Risks were estimated for all aquatic species using this approach. However, additional analysis was determined to be necessary for special status species, since chemical exposures may adversely affect vulnerable populations by impacts other than the death of individuals, such as by interfering with migration or reproduction. These are termed "sublethal effects." This analysis is presented in detail in Appendix D, and summarized in the following paragraphs.

Along with impacts to general aquatic species, risks of sublethal effects to a special status species known to be present in the Clear Creek and Milk Creek watersheds—the steelhead trout—were estimated in the non-target species risk assessment. As identified in Section 3.7.4, three additional special status aquatic species (chinook and coho salmon, Pacific lamprey) are located in the watershed; however, acute risks were not quantified for these species in the risk assessment, due to lack of information on populations of coho salmon and Pacific lamprey, and to the distance from the seed orchard of chinook salmon (more than 10 miles downstream), which is associated with a negligible potential for measurable mortality impacts. These additional special status species are, however, included in this assessment of the potential for sublethal effects.

The sublethal effects evaluated in this risk analysis for special status aquatic species are those that are relevant to biological requirements of the animal: in this case, rearing and migratory effects, and reproductive endpoints (NOAA 2002). Survival is also included in this analysis.

The assessment endpoints used to characterize potential effects reflect measures of the animal's health that can be functionally related to survival, rearing and migratory behavior, or reproductive success (NOAA 2002). Since relatively few scientific studies have examined sublethal effects of pesticides on fish physiology or behavior, the selection of assessment endpoints is limited. In the absence of data specific to the identified species of concern, data from biologically and genetically similar surrogate species were used. Comparative toxicology has demonstrated that various species of scaled fish generally have equivalent sensitivity (within an order of magnitude) to other species tested under the same conditions. Dwyer et al. (1995) and Beyers et al. (1994), among others, have shown that endangered and threatened fish tested to date are similarly sensitive to a variety of pesticides and other chemicals as their non-endangered counterparts. Very few studies have investigated the effects of pesticides specific to the lamprey, so comparative toxicity with fish species from available literature is made cautiously. In some cases, in the absence of sublethal effects data on a specific chemical for appropriate fish species, information was evaluated for pesticides which are chemically similar and share a common mechanism of toxicity.

For the purpose of broadening and strengthening the best available science for this evaluation, the proposed-use chemicals were analyzed by chemical groups. The insecticides and acaricides are divided by chemical classes (biologicals, organophosphates, organosulfites, and pyrethroids), reflecting a common mechanism of toxicity for each class. The herbicides, fungicides and fumigant, other ("inert") ingredients, fertilizers, and "other pesticides" (not inclusive within any other group classification) were evaluated wholly by their respective groups. In each case, the lowest toxicity result (indicating greatest toxicity) was used in the analysis of risks, so that this categorization approach would not sacrifice a protective analysis.

Appendix D provides details of the sublethal effects literature and analysis of risk values. Table 4.7-1 summarizes the lowest (most sensitive) toxicity values identified during this process. These data points are not intended to be definitive of all possible adverse effects at all life-stages related to survival, migration, or reproduction, but are intended to be conservative, representative estimates.

Table 4.7-1. Summary of Special Status Species Toxicity Data

Pesticide	Effect Concentration (mg/L)		
	Survival	Migration	Reproduction
Biological insecticides	75	NA	NA
Organophosphates	0.001	0.01	0.0003
Organosulfites	0.008	NA	0.028
Pyrethroids	0.000025	0.0001	0.000004
Herbicides	0.033	0.046	2.0
Fungicides/fumigants	0.0049	NA	0.0065
Other pesticides	100	NA	NA
Other ingredients	0.32	0.1	8.0
Fertilizers:			
ammonia (as NH_3)	0.0074	NA	NA
nitrate (as NO_3)	2.0	NA	NA
phosphate	49	NA	NA
calcium nitrate	480	NA	NA

NA = No data available.

Risks to special status species were determined by comparing the stream concentrations estimated in the risk assessment and the toxicity data endpoints summarized in Table 4.7-1. A concentration-effects ratio was determined, defined as the estimated chemical concentration in surface waters over the effect concentration. Risks to survival, migratory, and reproductive endpoints were predicted as follows:

- low if the concentration-effects ratio was 0.1 or below,
- moderate if the ratio was 0.1 to 1.0, and
- high if the ratio was 1.0 or greater.

For example, if the stream concentration of a given chemical is estimated to be 0.003 mg/L, and the concentration of that chemical which affects reproduction is 0.006 mg/L, then the concentration-effect ratio would be 0.5—a moderate risk to the fish.

4.7.2 Potential Impacts of Alternative A—Maximum Production IPM

4.7.2.1 Vegetation

Biological, cultural, and prescribed fire methods of pest control are not expected to present any adverse impacts to non-target vegetation.

Although the proposed herbicides are variously toxic to plants with which they come into contact, there should be no undesired impacts if properly applied. No special status plant species have been identified on-site at the seed orchard. Broadcast applications of herbicides are only proposed for intensively managed or disturbed areas such as along roads and fences, within orchard units, or around facilities, while spot applications would be used to control weed species in less disturbed areas. Only spot hand applications would be conducted within the riparian buffer areas. Insecticides, fungicides, and fertilizers are only proposed for use in cultivated areas (seed orchard blocks and native species beds), so no direct contact with plant species in other areas is expected.

Aquatic plants may be present in streams and ponds that receive runoff from treated areas. A literature review was conducted to identify the levels at which any of the proposed chemicals may pose a hazard to aquatic plants (see Section 9.2.4 in the risk assessment report). For many chemicals, tests in algae were the only available data, and are expected to provide a sensitive endpoint for hazards to aquatic plants. For each chemical, the estimated water concentrations were compared to the levels of concern. None of the predicted concentrations in onsite streams, Swagger Creek, or Nate Creek exceed the effects criteria equivalent to 50% of the values reported in the literature summarized in the preceding paragraphs. Therefore, no adverse effects to aquatic plants are expected under typical or maximum conditions of pesticide or fertilizer application at Horning.

4.7.2.2 Terrestrial Species

Risks to General Terrestrial Species

No risks to terrestrial wildlife are predicted for biological or cultural controls. Risks to wildlife from prescribed fire were evaluated in detail in BLM (1991); this evaluation is summarized below:

> Many different wildlife (vertebrate) responses to fire have been reported. Fire effects on wildlife vary with (1) animal species complex, (2) mosaic of habitat types, (3) size and shape of fire-created mosaic, (4) fire intensity, (5) fire duration, (6) fire frequency, (7) fire location, (8) fire shape, (9) fire extent, (10) season of burn, (11) rate of vegetation recovery, (12) species that recover, (13) change in vegetation structure, (14) fuels, (15) sites, and (16) soils....

> In general, fire affects wildlife by direct killing, alteration of immediate postfire environments, and postfire successional influences on habitat.... Direct killing of vertebrates by prescribed burning is rare.... For those species that cannot flee a burn, the most exposed habitat sites are dry exposed slopes, hollow logs with a lot of exposed wood, burrows less than five inches deep, lower branches of trees and shrubs, and poorly insulated underground/ground nesting areas.... Effects of prescribed burning on ground cover depends on fire severity: low severity fire on wet sites would remove less cover than high severity fires on dry sites. Escaped prescribed burns may accidentally destroy riparian habitats and impact aquatic resources, causing losses of wildlife through exposure, total loss of habitat, and increased sedimentation of the aquatic habitat caused by unchecked overland flow and destabilized stream channels.
>
> Fire mainly affects wildlife through habitat alteration.... Fire may have a positive effect on wildlife habitats by creating habitat diversity, by re-creating lost or degraded habitats for indigenous species, and by allowing for the re-introduction of extirpated species when habitat degradation was significant to their [local] extinction. Immediate postfire conditions raise light penetration and temperatures on and immediately above and below soil surfaces and can reduce soil moisture.... Burning of cover and destruction of trees, shrubs, and forage modify habitat structure.... The loss of small ground cover and charring of larger branches and logs (with diameters greater than 3 inches) can negatively affect small animals and birds. Early, vigorous vegetation growth immediately after a fire alters feeding and nesting behaviors.... Postfire plant and animal succession effects creating seral and climax mosaics in habitat cannot be generalized in their effects on wildlife.... Negative impacts can be lessened if the period of treatment avoids the bird nesting season and other critical seasons when loss of cover would be critical to wildlife; for example, during critical reproductive periods and prior to severe winter weather conditions.

Because the seed orchard is an intensively managed site, and only limited areas would potentially be treated with prescribed burning, negligible impacts to wildlife are expected from vegetation control using prescribed fire.

Risks to terrestrial wildlife from pesticide and fertilizer use under Alternative A are summarized in Table 4.7-2.

Similar to the negligible risks to humans, minimal to no risks are predicted for nontarget mammals from the biological insecticide *B.t.* Avian studies demonstrated that *B.t.* was practically nontoxic to mallard ducks and bobwhite quail after five days of oral dosing at up to 2,900 mg/kg/day, indicating negligible toxicity to bird species (EPA 1998a). No impacts to terrestrial animals are expected from the use of *B.t.*

The insecticide imidacloprid, which was not previously analyzed, is proposed for use only in the form of the Imicide® product, a capsule implanted directly into a tree. No exposure to terrestrial species would occur. In terms of risks to mammalian wildlife, it is also instructive to note that the active ingredient imidacloprid is the same as that found in the Advantage® dog and cat flea control products, which are applied directly to the skin of animals at a recommended dose rate and frequency of 10 mg/kg body weight once per month.

Little to no terrestrial species risk from seed orchard use of Safer® Insecticidal Soap is indicated by the active ingredient's short half-life (less than one day), natural occurrence of the degradation products (fatty acids), and low toxicity (oral LD_{50} of 74,000 mg/kg for the fatty acid oleic acid, and five-day $LC_{50} > 5{,}000$ ppm in food for mallard ducks and bobwhite quail) (EPA 1992).

Risks are predicted from chlorpyrifos for the black-capped chickadee in the typical and maximum scenarios, and for the song sparrow in the maximum scenario.

Risks are predicted from diazinon for the black-capped chickadee and California quail in the typical and maximum scenarios, and for the mallard duck, red-tailed hawk, and song sparrow in the maximum scenario.

Dimethoate was estimated to present risks to the black-capped chickadee, California quail, song sparrow, and Pacific tree frog in the typical scenario, and to all general terrestrial species except the coyote and jackrabbit in the maximum scenario.

Table 4.7-2. Summary of Scenarios with Predicted Non-Target Species Risks Under Alternative A

Chemical	Scenario	Species	Risk*
Risks to General Terrestrial Wildlife			
Chlorpyrifos	Airblast	Black-capped chickadee	Q = 1.84 (typical) and 7.59 (maximum)
		Song sparrow	Q = 0.657 (maximum)
Diazinon	High-pressure hydraulic sprayer	Black-capped chickadee	Q = 6.05 (typical) and 63.4 (maximum)
		California quail	Q = 0.845 (typical) and 9.31 (maximum)
		Mallard duck	Q = 1.69 (maximum)
		Red-tailed hawk	Q = 0.634 (maximum)
		Song sparrow	Q = 5.59 (maximum)
Dimethoate	High-pressure hydraulic sprayer	Black-capped chickadee	Q = 20.7 (typical) and 138 (maximum)
		California quail	Q = 3.80 (typical) and 31.1 (maximum)
		Song sparrow	Q = 3.66 (typical) and 43.2 (maximum)
		Pacific tree frog	Q = 23.9 (typical) and 135 (maximum)
		Cow	Q = 1.22 (maximum)
		Sheep	Q = 2.45 (maximum)
		Long-eared myotis	Q = 1.27 (maximum)
		Mallard duck	Q = 0.857 (maximum)
		Red-tailed hawk	Q = 6.26 (maximum)
Risks to Special Status Terrestrial Species			
Chlorpyrifos	Airblast	All	Q = 0.125 to 0.604 (typical) and 0.600 to 2.53 (maximum)
Diazinon	High-pressure hydraulic sprayer	All	Q = 0.416 to 1.98 (typical) and 5.11 to 21.4 (maximum)
Dimethoate	High-pressure hydraulic sprayer	All	Q = 3.34 to 6.77 (typical) and 33.5 to 53.5 (maximum)
Calcium nitrate	Cone stimulation	Western pond turtle	Q = 0.116 (typical) and 0.233 (maximum)
		Common nighthawk	Q = 0.114 (maximum)
		Oregon vesper sparrow	Q = 0.107 (maximum)
Risks to General Aquatic Wildlife			
None	None	None	None
Risks to Special Status Aquatic Species			
None	None.	None.	None.

*Risks are predicted for general terrestrial species if Q > 0.5; for special status terrestrial species if Q > 0.1; for general aquatic species if Q > 0.5, and for special status aquatic species if Q > 0.05.

In most cases, little or no adverse impact to terrestrial wildlife populations is expected from the pesticides and fertilizers proposed for use at Horning under typical conditions of use, with the possible exception of impacts to bird and amphibian species from applications of three of the insecticides (chlorpyrifos, diazinon, and dimethoate). Most of the estimated doses are extremely low, with risk quotients several orders of magnitude below the levels of concern. A margin for error is provided by the methodology applied, which uses reasonable assumptions that tend toward overstating potential exposures to wildlife, in the absence of site-specific data on potential exposure patterns. In addition, the chemicals have relatively short half-lives and are not expected to remain in the environment for significant periods of time: two herbicides (hexazinone and picloram) have soil half-lives in the five to six month range, while the rest of the pesticides' soil and foliar half-lives are less than three months.

Although some terrestrial insects onsite may be affected by the insecticide applications, and may constitute a portion of the dose to insectivorous species, populations of beneficial insects as a whole are not expected to suffer adverse impacts because the proposed seed orchard applications are localized. Although honeybees and other pollinators are generally susceptible to insecticides, including the biological insecticide *B.t.*, the protection measures that are part of all the alternatives include practices to minimize potential exposures; see Section 2.3.1.

It appears that insecticide applications may have adverse impacts on local earthworm populations (see discussion in Section 9.2.1 of the risk assessment report). However, any possible impacts are expected to be reversible, given that these chemicals are not persistent in the soil and that limited areas would be treated only on an as-needed basis in any growing season, allowing for re-population from adjacent untreated areas.

Risks to Special Status Terrestrial Species

Risks are predicted from chlorpyrifos, diazinon, and dimethoate for all special status terrestrial species in both the typical and maximum scenarios.

Calcium nitrate application was estimated to pose a risk to the western pond turtle in both typical and maximum scenarios, and to the common nighthawk and Oregon vesper sparrow in the maximum scenario.

Risks from Accidents

Risks are predicted for all terrestrial species except the cow, sheep, and coyote in the scenario in which an animal ingests an acephate implant capsule.

General terrestrial species were predicted to be at risk from a concentrate spill of diazinon, esfenvalerate, or dazomet at the mixing area.

4.7.2.3 Aquatic Species

Since biological, cultural, and prescribed fire methods are expected to have no significant impacts to surface water (as discussed in Section 4.4.2.2), no impacts to aquatic species would occur from the use of those methods.

Any chemical concentrations in Milk Creek are likely to be less than those predicted in the risk assessment. The risk assessment assumed that any chemical entering Stream 8, in the southwest portion of Section 23, could enter Milk Creek (see Figure 3.4-2 for location of Stream 8). Stream 8 is ephemeral north of Unger Road (see Figure 2.1-1 for location of Unger Road); however, this flow goes underground before reaching the road. Flow resurfaces near the BLM property line. There is no direct surface connection between Streams 8d and 8e and Milk Creek.

Risks to General Aquatic Species

No risks of lethal effects to general coldwater fish species, aquatic invertebrates, or aquatic stages of amphibians were predicted in onsite streams in the typical or maximum scenarios in the risk assessment (summarized in Appendix C).

Drift from permethrin airblast applications was predicted to exceed the 21-day MATC for aquatic invertebrates in onsite streams. However, this permethrin concentration would persist for less than 24 hours, compared to the three-week exposures used to calculate this criteria. Therefore, this comparison is not expected to indicate a potential risk.

Laboratory toxicity studies and field observations indicate that *B.t.* would not have any adverse effect on fish species (EPA 1998a). However, moderate toxicity to the water flea *Daphnia magna* (EPA 1998a) indicates that some impacts to aquatic invertebrates could be possible if the biological insecticide entered surface water. Such impacts would be expected to be localized and temporary, since the bacterium does not proliferate in aquatic habitats. Buffer zones and other standard protection measures (see Chapter 2) would minimize the potential for any surface water contamination.

The insecticide imidacloprid, which was not previously analyzed, is proposed for use only in the form of the Imicide® product, a capsule implanted directly into a tree. Movement of imidacloprid is restricted to the vascular system of the tree. The potential for imidacloprid to enter air, soil, or water is negligible when using Imicide® capsules. Although imidacloprid residues have been found in leaves and needles following Imicide® application, vegetation buffers, which are a minimum of 40 feet between potentially treated trees and live water, would be expected to intercept needles or leaves that may fall from treated trees. (Observation of fallen needles within orchard units indicates that needles generally fall close to the drip line of trees and are held within the dense grass cover crop once they become wet.) With a 96-hour LC_{50} of 211 mg/L reported for rainbow trout and a 48-hour LC_{50} of 85 mg/L reported for the water flea *Daphnia magna,* toxicity to aquatic species is expected to be low (Extoxnet 2003). Therefore, in the unlikely process by which any residues could be moved by needle drop □ weathering □ runoff □ downstream transport, the resulting concentrations would be expected to be many orders of magnitude below those associated with any type of effect on aquatic species.

Soap salts such as potassium salts of fatty acids, the active ingredient in Safer® Insecticidal Soap, are only slightly toxic to fish, but are highly toxic to aquatic invertebrates (EPA 1992). However, they are not applied directly to water in the the proposed seed orchard IPM program, nor in any other labeled uses of this product. Their quick (less than one day) degradation and low-impact application methods (spraying individual trees in managed orchard units) would be associated with little opportunity for transport to surface water, and thus they would pose little risk to aquatic species.

Risks to Special Status Aquatic Species

<u>Risks of Lethal Effects</u>

In the lethality effects evaluation contained in the risk assessment (summarized in Appendix C), ammonia in runoff from general orchard fertilization was predicted to pose a risk to resident cutthroat trout in Section 13 onsite streams in the maximum scenario only. However, since cutthroat is no longer considered a special status species at Horning, the more restrictive criteria that resulted in this conclusion in the risk assessment do not apply. No lethality risks to special status species in any other streams were identified in the risk assessment. Therefore, no lethality risks are expected for special status aquatic species.

Risks of Sublethal Effects

The risk analysis of sublethal effects to special status aquatic species is presented in Appendix D and summarized in the following paragraphs.

For all of the proposed insecticides, including the biological insecticide *B.t.*, it is conceivable there could be a localized loss of part of the insect food source for fish species due to drift or runoff to streams. However, any chemical presence and associated decrease in non-target aquatic insect populations would be temporary and localized. Therefore, no indirect effects to fish from loss of insect food sources are expected. Additionally, no adverse effects are expected for aquatic invertebrates in the general aquatic species analysis, so no impacts to food sources for special status fish are expected.

Typical applications of *B.t.*, organophosphates, organosulfites, and pyrethroid insecticides are expected to pose low risk to special status species in all surface waters for the sublethal effects evaluated.

Maximum applications of *B.t.* and organosulfites are expected to present low risk in all surface waters for all biological endpoints. Maximum scenario risks from the organophosphates and pyrethroids are low in Swagger Creek, Milk Creek, and Clear Creek; but there are moderate risks for reproductive effects from these two types of insecticides in Nate Creek. However, no special status aquatic species are known to occur in Nate Creek in the vicinity of the orchard where these concentrations were estimated. Therefore, no insecticide exposures resulting in maximum scenario risks of sublethal effects to special status species are predicted to occur. In addition, monitoring and gauge records at Horning indicate that precipitation occurring during the spring and summer months does not usually induce surface runoff, resulting in the conclusion that contamination reaching surface water via runoff is unlikely during the time of year during which there is more potential for use of chemical pesticides.

Typical and maximum applications of all herbicides, fungicides and fumigant, other pesticides, and other ingredients are associated with low risk to special status species in all streams for all sublethal effects evaluated.

Typical applications of fertilizers are expected to present low risk in all streams for the biological endpoints evaluated. Under the maximum scenario, fertilizer applications were estimated to present moderate risks of ammonium toxicity to special status species in Swagger Creek, Milk Creek, and Clear Creek. Although high risks for ammonium toxicity to special status species would be predicted for Nate Creek, no special status aquatic species are known to occur in Nate Creek in the vicinity of the orchard.

Risks from Accidental Spills

Most categories of aquatic species (fish, invertebrates, amphibians, both general and special status) are at risk of lethal effects from spills of tank mixtures of chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, propargite, chlorothalonil, dicamba, glyphosate (Roundup®), hexazinone, horticultural oil, picloram, and triclopyr butoxyethyl ester into the irrigation pond, or into onsite tributaries to Swagger Creek and Nate Creek. No risks were predicted in any spill scenarios from acephate, propiconazole, glyphosate (Rodeo®), or triclopyr triethylamine salt. Risks would be lower for species not found nearer to the seed orchard than Clear Creek or Milk Creek, due to greater dilution. The details of the modeled accidental spills are presented in Section 3.2.5 of the risk assessment report.

4.7.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Alternative B was designed in response to the results of the quantitative risk assessment, by incorporating limitations to specifically address any risks from applications under Alternative A (which are summarized in Table 4.7-2). The risks from Alternative A (from Table 4.7-2) and the corresponding limitations that address the risks (from Section 2.3.3) are correlated in Table 4.7-3. With these risk-responsive limitations as an integral part of Alternative B, no adverse effects to terrestrial wildlife or to aquatic species, including special status fish species, are expected from the use of chemical pesticides under this alternative.

BLM's biological assessment concluded that that surface waters utilized by Upper Willamette River or Lower Columbia River steelhead are unlikely to be contaminated at levels high enough to result in either lethal or sublethal effects, and therefore implementation of the proposed IPM alternative may affect, but is not likely to adversely affect, these threatened steelhead ESUs. NOAA Fisheries responded with a biological opinion concluding that the proposed action is not likely to jeopardize the continued existence of Lower Columbia River chinook salmon, Upper Willamette River chinook salmon, Upper Willamette River steelhead, Lower Columbia River steelhead, or Lower Columbia River coho salmon; the opinion specified reasonable and prudent measures, with associated terms and conditions, to further protect the species. See Section 2.3.3 for additional details.

Table 4.7-3. Risk-Responsive Limitations to Protect Ecological Resources Under Alternative B

Identified Risk from Alternative A			Alternative B Limitation that Addresses Risk
Chemical	Scenario	Species	
Chlorpyrifos	Airblast	Conifer-seed-eating birds, all special status terrestrial species	Would not be applied within 25 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods). It would not be applied to more than three acres in any 12-acre area within a 14-day period, at a rate no greater than 1 lb a.i. per acre.
Diazinon	High-pressure hydraulic sprayer	Seed-eating birds, game birds, insect-eating birds, water fowl, raptors, all special status terrestrial species	Would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods). It would not be applied to more than 150 trees at a rate of 0.015 lb a.i. per tree (nor any combination of number of trees and application rate more than 2.25 lb a.i. applied) in any 12-acre area within an 11-day period.
Dimethoate	High-pressure hydraulic sprayer	Seed-eating birds, game birds, insect-eating birds, water fowl, raptors, reptiles/amphibians, domestic and wild mammals, all special status terrestrial species	Would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods). It would not be applied to more than five trees at a rate of 0.13 lb a.i. per tree (nor any combination of number of trees and application rate more than 0.65 lb a.i. applied) in any three-acre area within a seven-day period.
Calcium nitrate	Cone stimulation	Western pond turtle, Oregon vesper sparrow, common nighthawk	If calcium nitrate is applied to trees that are within 500 feet of streams after April 30, the fertilizer in these areas would be "watered in" if there is no rainfall within a week. During calcium nitrate applications, orchard employees would be vigilant for nests of ground-nesting bird species.

Should an accidental spill to surface water occur, the risks from that accident would be the same as those identified under Alternative A. However, the probability of an accident is decreased by limitations on transport of pesticide concentrate over certain tributaries (see Section 2.3.3).

Risks from biological, prescribed fire, cultural, and other methods of pest control are the same as under Alternative A.

4.7.4 Potential Impacts of Alternative C—Ground-Based IPM

Since no risks are predicted for terrestrial or aquatic wildlife species from aerial esfenvalerate application under Alternative B, the omission of that method from the alternative does not change the risks. The risks from Alternative C would be the same as from Alternative B: no risks to terrestrial or aquatic wildlife, including special status species, from chemical pesticides or fertilizers except in the case of accidents. Risks from biological, prescribed fire, and cultural methods of pest control are the same as under Alternative A.

4.7.5 Potential Impacts of Alternative D—Non-Pesticide Pest Management

Under Alternative D, there would be no risks from pesticides since they would not be used. As discussed under Alternative A, no risks to non-target species from biological, cultural, prescribed fire, or other control methods would be expected from their use in an IPM program at Horning, except for fertilizers, which would pose the same risks as under Alternative A.

4.7.6 Potential Impacts of Alternative E—No Action: Continue Current Management Approach

If BLM continued its current management approach, risks from pesticides would be intermediate between Alternative A and Alternative D. Pesticides would likely be used less frequently, due to the need to conduct individual NEPA analyses for each project. Therefore, the potential for risks from pesticides, including accidents, would be lower. Impacts from biological, prescribed fire, and cultural methods of pest control would be higher than under Alternatives A, B, or C, due to their increased use compared to those alternatives. Impacts from fertilizers would be the same as under Alternative A.

4.8 Noise

The proposed action or an alternative could produce occasional short-term impacts on the noise environment, but the impacts would not be significant. Alternatives A and B would include occasional helicopter noise from aerial applications; however, the impacts would not be significant since these applications would occur for only a few hours once or twice a year. Ground equipment noise associated with any pest management alternative would not significantly influence the noise environment, because the noise generated would be intermittent and would occur during daytime hours, would be attenuated by the equipment's distance from noise receptors, and would be indistinguishable from the use of the same or similar equipment for non-pest management activities. Under the no action alternative, noise levels would be unchanged.

4.8.1 Analysis Approach and Assumptions

The analysis of noise impacts involved assessing the estimated noise levels from the proposed action and alternatives, comparing them with ambient noise levels, and identifying the presence of any sensitive receptors near the seed orchard. Maps of the Horning vicinity were used to determine the locations of sensitive receptors.

Noise perception and annoyance to the public depend on the intensity of the sound (measured in dB), the frequency of the sound (high or low pitch), and the duration of the noise (steady, intermittent, or impulsive (sudden)). For single noise events, an increase of 3 dB is perceived by most people as barely louder. An increase of 6 dB is perceived as noticeably louder, and an increase of 10 dB is perceived as twice as loud (Cavanaugh 1998).

Aircraft noise is usually perceived as louder because of its frequency. Sudden impulsive sounds are also perceived as louder (FAA 1985). Helicopters generate a distinct noise which is a mixture of noise from many sources: engine, aerodynamics, main rotor, tail rotor and interaction of the vortices created by the two rotors. Blade slap is typically annoying, but it is not present in some maneuvers, speeds, and rotor configurations (HDOT 1994). A helicopter flying overhead at an altitude of 30 feet produces 85 dB at a distance of 600 feet.

There are two basic considerations for protecting the community from increased noise from short-term sources. To protect human health, noise levels must not exceed limits identified with potential loss of hearing. An L_{eq} of 73 dB sustained over 8 hours for 250 days or more per year can cause hearing loss to a general population over a prolonged time period (about 40 years) (EPA 1974). The other consideration for protecting the public is noise interference with activity, or annoyance. This depends upon the setting in which the increased noise takes place, for both indoor and outdoor activities. Thresholds for various uses vary from 45 L_{eq} (averaged over 24 hours) within residences and other locations based on a quiet use, to 70 L_{eq} (averaged over 24 hours) for outdoor exposure in recreational areas (EPA 1974). Communities that typically experience higher noise levels tolerate higher increases in noise (typically 5 dB more without complaints).

The impact on the noise environment is related to the magnitude of the noise levels and the proximity of noise-sensitive receptors to the noise source. Increasing the L_{eq} (averaged over 24 hours) to 73 dB or above for one year or more could be a significant impact, as this could potentially cause hearing loss in a portion of the general public. If noise levels increased, but affected noise-sensitive receptors to a level below 73 L_{eq}, the impact would not be significant. A decrease in noise levels would be a beneficial impact.

4.8.2 Potential Impacts of Alternative A—Maximum Production IPM

Normal background noise levels average about 45 to 50 dBA at Horning and in the surrounding area. The ground-based IPM activities associated with Alternative A (tractors and other equipment) would negligibly increase noise levels at Horning for short periods, and the type of noise impact would be similar to the current noise environment at Horning. As noted in Table 3.8-2, at 1,600 feet away from the noise source, composite noise would attenuate to the area's ambient noise level.

Alternative A also includes aerial insecticide applications by helicopter. Horning would use helicopter applications at most two times per year during normal weekday working hours, and the duration of each application would not exceed a few hours. The occasional helicopter use, which would be similar to that at adjacent privately-owned timber farms, would increase noise levels on and around the orchard during

the operations and could produce short-term annoyance among nearby residents, but impacts would be insignificant. Livestock on neighboring lands could experience minor startle effects during helicopter operations, but impacts to livestock would also be insignificant because of the infrequency and short duration of helicopter events.

There are no sensitive receptors within 1,000 feet of the seed orchard. There would be no significant noise impacts.

4.8.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Under Alternative B, which includes both ground-based and aerial applications, impacts would be essentially the same type as under Alternative A, but could be slightly less if equipment use were reduced. Noise impacts would be insignificant.

4.8.4 Potential Impacts of Alternative C—Ground-Based IPM

Under Alternative C, only ground-based applications would be used. Noise impacts for ground equipment would be the same as under Alternative B, but there would be no helicopter noise. Noise impacts would be insignificant.

4.8.5 Potential Impacts of Alternative D—Non-Pesticide Pest Management

Under Alternative D, no pesticides would be used, and noise impacts could be similar to or less than the impacts under Alternative C, depending on the types of mechanical control used. There would also be no helicopter noise. Noise impacts would be insignificant.

4.8.6 Potential Impacts of Alternative E—No Action: Continue Current Management Approach

Under Alternative E, the current insignificant noise impacts would continue. Before BLM applied any pesticides, including by helicopter, an EA would be prepared to determine potential impacts of that application, and would include an assessment of potential noise impacts to the area, if appropriate.

4.9 Cultural Resources

Cultural resources are limited, nonrenewable resources whose values may easily be diminished by physical disturbances. There are no important cultural resources at Horning, and the grounds have been disturbed over the years of the orchard's operations. The proposed action and alternatives include no construction or excavation activities that could disturb any undiscovered cultural resources either on or adjacent to the orchard. There would be no impacts to cultural resources from any alternative.

4.9.1 Analysis Approach and Assumptions

To determine potential impacts, the analysis focused on the types of activities that would occur, the location where they would occur, and the significance of the resource in that location. NEPA documents and past archaeological and historic resources surveys were reviewed. BLM and the State Historic Preservation Office (SHPO) were consulted for the latest information concerning cultural resources on the seed orchard.

The criteria used to determine the significance of impacts on cultural resources includes the effects on NRHP eligibility, future research potential, or suitability for religious or traditional uses. An impact could be significant if it resulted in the physical alteration, destruction, or loss of a resource listed or eligible for listing in the NRHP. An adverse impact could not be significant if only slight portions of the resource were affected or if the value of the resource was not important. The impact of the action could be beneficial if it protected or reconstructed the resource.

4.9.2 Potential Impacts of All Actions

As noted in Section 3.9, no important cultural resources have been identified at Horning, and the grounds have all been disturbed during the years of the orchard's operations. There are no nearby Native American religious sites. Neither the proposed action nor any alternative includes construction or excavation activities that could disturb any undiscovered cultural resources either on or adjacent to the orchard. There would be no impacts to cultural resources from any alternative.

In the unlikely event that archaeological materials were encountered during project activities, work in that location would cease until the artifacts were evaluated by a qualified archaeologist, and the BLM had consulted with the Oregon SHPO if applicable.

4.10 Socioeconomics and Environmental Justice

Socioeconomic impacts are generally related to changes in an area's population, number of jobs, employment structure, or income. No population or employment impacts are projected for the proposed action or any alternative at Horning. However, income in the ROI could be affected by changes in the land's productivity or value, or in the marketability of its products. There are three possible factors that would lead to economic impacts: offsite pesticide transport to a neighboring land parcel used for organic farming; decreased production on and adjacent to the seed orchard if pest control methods are not successful; and pest infestation on and adjacent to the seed orchard if pest control methods are not successful. The potential for impacts to the organic farm is negligible, with the probability for impact slightly higher under Alternative A. Decreased production is least likely under Alternative A, and increases successively with Alternatives B and C having a similar effect, and Alternative D having the greatest potential for this impact. Economic loss from uncontrolled pest infestation is most likely under Alternative D, and is unlikely under Alternatives A, B, or C. Overall, socioeconomic and environmental justice impacts would be insignificant under Alternatives A, B, C, or D. Similarly, under Alternative E (no action), the current insignificant impacts would be unchanged.

4.10.1 Analysis Approach and Assumptions

Measures used for impact analysis include population, employment, and income. The analysis used population data from the USBC, and employment and income data from the U.S. Bureau of Economic Analysis and the Oregon Employment Department. To predict impacts to socioeconomic resources in a given ROI, significance criteria were determined by analyzing long-term fluctuation in elements such as population, employment, and income within that ROI. This approach allows an ROI-specific determination of the appropriate levels, or thresholds, beyond which changes in an element would noticeably affect individuals and communities. The analysis compares each element's actual yearly change to the predicted amount of change, which, in turn, is based on the average annual change that has occurred over the long-term period used as a basis for the analysis (1980-2000). The annual deviations between actual change and predicted (average) change are the basis for determining a threshold of significance

for each element. Regions are assumed to have a greater capacity for positive change—growth—than for negative change; therefore, the negative income threshold is decreased by one-third to avoid understating impacts from actions that may result in a decline in income. Based on this methodology, a significant adverse impact for this ROI (Clackamas County) would be a decline of more than 7% in projected income as a result of an action assessed in this EIS. An increase in income would be considered beneficial. Since no employment or population changes are anticipated, no significance criteria were defined for those measures.

There are no disproportionate populations of low-income or minority persons, or children, in the areas surrounding Horning. Therefore, no environmental justice impacts would occur under any alternative considered in this EIS.

4.10.2 Potential Impacts of Alternative A—Maximum Production IPM

Under Alternative A, the risk assessment predicted negligible contamination to neighboring land parcels, one of which is a certified organic farm growing herbs and mushrooms. (This farm is located northeast of the seed orchard; see Figure 3.5-1.) While the probability of pesticide drift contaminating this farm is extremely low, unforeseen weather conditions coupled with a failure to quickly respond to adverse conditions by ceasing the application could increase the possibility of such an impact. The individual impact to the organic farm would be significant if pesticide residues were sufficient to cause the farm to lose its organic certification and, consequently, its ability to certify and market its produce as organic. The overall economic impacts of inadvertent contamination would be insignificant to the landowners surrounding Horning and to the ROI.

Economic losses due to increases in insects or disease, or to pest infestation, are very unlikely. Impacts would be insignificant.

4.10.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Under the proposed action, the more controlled application procedures (see Section 2.3.3) would further reduce the risk of offsite pesticide transport to neighboring land parcels, including the organic farm. The potential economic impacts to neighboring landowners from pesticide drift would be as described under Alternative A, but the likelihood for such impacts would be reduced. Production losses due to increases in insects or disease, or to pest infestation, are very unlikely. Impacts to income would be insignificant.

4.10.4 Potential Impacts of Alternative C—Ground-Based IPM

Under Alternative C, socioeconomic impacts would be similar to those predicted for Alternative B. Although it is a common perception that aerial spraying has the greatest potential for off-site drift, the risk assessment modeling concluded that a ground-based method (airblast sprayer) had more potential for drift deposition at the distance to the organic farm, given the specific wind direction. The potential risk of economic loss from contaminating nearby land parcels, such as the nearby organic farm, would be negligible. The likelihood of production losses due to increases in insects or disease, or to pest infestation, is similar to Alternative B. Impacts to income would be insignificant.

4.10.5 Potential Impacts of Alternative D—Non-Pesticide Pest Management

Under Alternative D, no pesticides would be used, so there would be no possibility of pesticide transport to nearby land parcels. However, reduced production and/or pest infestation could result if non-pesticide pest control methods were not successful, resulting in economic losses. If the pest infestation were to spread from the seed orchard to neighboring land parcels whose crops were susceptible to those pests, those landowners would also suffer an economic loss. Although there could be localized economic losses, the overall impact to the ROI would be insignificant.

4.10.6 Potential Impacts of Alternative E—No Action: Continue Current Management Approach

Under Alternative E, the current insignificant economic impacts would continue. Before BLM undertook a pesticide application, an EA would be prepared to determine potential impacts of that application. The EA would include an assessment of the potential to contaminate neighboring land parcels and the consequent economic impacts.

4.11 Cumulative Impacts

According to CEQ regulations at 40 CFR 1508.7, "cumulative impact" is the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

In terms of pesticide or fertilizer application, other agencies or private individuals in the vicinity of the orchard may be using other treatments with many of the same chemicals as BLM proposes to use. Also, applications may be used in agriculture, forestry, or industrial operations that might create an overall chemical burden in the orchard area. While the chemicals used in the proposed IPM program are not expected to have an impact on water quality, streams that may receive some pesticide or fertilizer drift or runoff from the orchard also may be receiving drift or runoff of chemicals from other locations, and this cumulative burden may place the aquatic ecosystems at risk. The 1985 Clackamas County Soil Survey (SCS 1985) found 8% of the county's land area to be urban, 50% in timber, and 35% in crops, hay, or pasture. Horning's total orchard acreage accounts for 0.2% of the county's farm acreage and 0.1% of county timber acreage. Therefore, Horning's proposed IPM program is not expected to be present a significant contribution to the cumulative impacts to the environment from pest management in Clackamas County.

The human health risk assessment addressed cumulative risk to members of the public and workers from all of the pesticides and fertilizers as proposed for use under Alternative A, and from the subset of pesticides that are more likely than others to be used in a given year. Since no data exist indicating synergistic toxicity among the pesticides proposed for use at Horning, cumulative human health risks were estimated assuming additive toxicity. No risks to members of the public were predicted from these aggregated exposures. For workers, the highest cumulative exposure could occur if one employee was involved in all pesticide applications, with the exception of aerial applications, which are always conducted by a contractor. In this case, a risk of health effects is predicted, as the cumulative dose exceeds the acceptable level by a factor of 39.5 for noncarcinogenic effects, and the cumulative cancer risk is 7.15 in one million, which is slightly greater than the generally accepted level of one in one million. It is important to

note that this cumulative risk scenario includes the unlikely case in which all pesticides that target every pest problem are called for during the season. The highest contributor to the cumulative hazard index is dimethoate, and the main contributor to the cancer risk is propargite. For the subset of pesticides more likely to be used, no risks to workers were predicted. Actual cumulative risk values are likely to be less than the results estimated in this conservative analysis for the following reasons:

- It is highly unlikely that one individual would be exposed to every chemical in all of the scenarios evaluated in the risk assessment;

- Several pesticides are proposed for use as alternatives for certain groups of target pests or weeds, and if one were selected for use in a given season, the alternatives would not also be used;

- To avoid underestimating risk, where multiple application methods are possible for a proposed pesticide treatment scenario, the method with the highest associated risk was included in the cumulative assessment; and

- The temporal spacing of the potential chemical applications would correspond to a timeline in which some exposure routes were no longer active due to dissipation and degradation, prior to application of other chemicals.

4.12 Mitigation Measures

Alternative A.

Based on the results of the quantitative risk assessment, the selection of Alternative A, Maximum Production IPM, could result in environmental impacts to human health and biological resources. Therefore, CEQ's regulations for implementing NEPA require that potential mitigation measures for these consequences be identified in this EIS. The following measures have been identified to mitigate the risks predicted for Alternative A:

- Diazinon would be applied to no more than 250 trees in one day at a maximum rate of 0.015 lb a.i. per tree (nor any combination of number of trees treated and application rate with a total amount of diazinon applied more than 3.75 lb a.i.) by any individual worker who is conducting both the mixing/loading and application activities.

- Dimethoate would be applied to no more than 22 trees in one day at a maximum rate of 0.13 lb a.i. per tree (nor any combination of number of trees treated and application rate with a total amount of dimethoate applied more than 2.86 lb a.i.) by an individual using the high-pressure hydraulic sprayer, and an individual other than the applicator would conduct the mixing/loading activities. If more than one applicator sprays trees during a single day, different mixer/loaders would prepare each pesticide mixture.

- An individual conducting hand pollination activities would not work on trees that had been treated with diazinon until at least 11 days post-application.

- An individual applying dicamba using a backpack sprayer would apply no more than 0.61 lb a.i. during any given day.

- An individual applying hexazinone using a backpack sprayer would apply no more than 6.5 lb a.i. during any given day.

- Greenhouse weighing/monitoring personnel would not handle seedlings treated with mancozeb for 14 days after application.

- Chlorpyrifos would not be applied within 25 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed

orchard unit (the distance associated with no drift from the proposed application methods). It would not be applied to more than three acres in any twelve-acre area within a 14-day period, at a rate no greater than 1 lb a.i. per acre .

- Diazinon would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods). It would not be applied to more than 150 trees at a rate of 0.015 lb a.i. per tree (nor any combination of number of trees and application rate more than 2.25 lb a.i. applied) in any twelve-acre area within an 11-day period.

- Dimethoate would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods). It would not be applied to more than five trees at a rate of 0.13 lb a.i. per tree (nor any combination of number of trees and application rate more than 0.65 lb a.i. applied) in any three-acre area within a seven-day period.

- Fertilizer application rates would be limited to those identified in the typical scenarios (see Table 2.2-1).

- If calcium nitrate is applied to trees that are within 500 feet of streams after April 30, the fertilizer in these areas would be "watered in" if there is no rainfall within a week. During calcium nitrate application, orchard employees would be vigilant for nests of ground-nesting bird species, particularly the Oregon vesper sparrow and common nighthawk, to avoid applying fertilizer to any nests.

Alternatives B and C.

BLM's proposed action: Alternative B, IPM with Environmental Protection Emphasis, and the limitations incorporated into it (see Section 2.3.3 of the EIS), are expected to address all potential risks identified in the EIS and risk assessment. During the ESA consultation process, NOAA Fisheries identified additional terms and conditions to provide additional protection to threatened steelhoud trout. These requirements are listed in Section 2.3.3 of this Final EIS. Alternative C, Ground-Based IPM, incorporates the limitations inherent to Alternative B, so no mitigation measures were identified; this alternative was not included in the ESA consultation process.

Alternative D.

No significant impacts would be associated with Alternative D, Non-Pesticide Pest Management, so identification of mitigation measures is not required.

Alternative E.

Mitigation measures for use of pesticides under Alternative E, No Action, would be identified on a project-by-project basis during the specific NEPA assessments.

The ROD that will be published at the conclusion of the EIS process will specify the mitigation measures that will be implemented with the selected alternative.

4.13 Unavoidable Adverse Impacts

Any alternative would result in adverse environmental effects that cannot be avoided. Protection measures, limitations, and mitigation measures developed in this EIS are intended to reduce the extent and duration of these effects. However, adverse effects cannot be completely avoided. There are two areas under Alternative A where potential risk was identified from the use of some pesticides and fertilizers in certain situations: human health (workers) and ecological resources (wildlife/aquatics). Specifically, the

human health risk assessment predicted some worker risk from the use of diazinon, dimethoate, propiconazole, dicamba, hexazinone and mancozeb in certain situations. In response to these identified risks, however, Alternative B was developed to limit chemical pesticide use such that these estimated worker and ecological risks would be reduced to negligible levels.

The ecological assessment predicted that the use of *B.t.* as a biological insecticide could impact populations of non-target beneficial insects in areas immediately adjacent to any treated orchard units. In addition, the use of pesticides could adversely impact bird and amphibian species from application of chlorpyrifos, diazinon, and dimethoate, although most of the wildlife exposures are very low. An analysis of the potential for sublethal effects on special status fish species identified potential risks to reproductive endpoints from typical applications of pyrethroids, and from maximum applications of organophosphates and pyrethroids. Potential risks to migratory endpoints were also identified for pyrethroid applications under maximum scenario conditions. As mentioned previously, Alternative B was designed in response to the risks identified for Alternative A, to limit chemical use and thereby reduce the estimated ecological risks to negligible levels.

There is also potential for additional adverse effects beyond those identified above. However, these also are expected to be negligible given the implementation of protection measures and limitations identified in this EIS. These include:

- Short-term reduction in air quality from dust and engine emissions resulting from IPM activities (power tools and mechanical equipment that burn fossil fuels, prescribed burning, and volatile and drift fraction of pesticides used in chemical methods);
- Temporary increase in fire hazard from waste material (dry vegetation) left on ground after treatment;
- Localized changes in terrestrial wildlife habitat;
- Localized lethal impacts to non-target insects from insecticide use, and to non-target plants from herbicide use; and
- Temporary health effects from prescribed burning (eye, throat, lung irritation).

The potential for adverse effects varies with each alternative and is discussed in greater detail in earlier sections of this chapter. Adherence to protection measures (and, under Alternatives B and C, limitations) would minimize the potential for any adverse environmental effects.

4.14 Relationship Between Short-Term Uses Versus Long-Term Productivity

Short-term uses are generally those that determine the present quality of life for the public, including BLM orchard employees. The short-term use of the orchard is to produce improved seed for conifer seedling production, preserve individual valuable conifer trees, produce native species plants and plant species seed, and produce containerized seedlings in a greenhouse nursery. This high-quality seed is supplied to BLM and other cooperators for reforestation and restoration projects. Long-term productivity refers to the capacity of the soils to support sound ecosystems that produce resources such as forage, wildlife, water, and timber. Long-term productivity for a seed orchard refers to the capabilities of the seed orchard to support production that will continue to sustain adequate quantities of high quality seed. The proposed pest management program is designed to protect and enhance the long-term productivity of the orchard, as well as contribute to the short-term uses.

The cultural and biological pest control methods associated with short-term uses have no known long-term adverse effects on productivity. The pesticides examined in this EIS also should have no adverse effect on long-term productivity because most dissipate in the environment relatively quickly and would not change the productivity of the natural environment.

4.15 Irreversible and Irretrievable Commitment of Resources

Implementation of the proposed IPM program at Horning would result in the commitments of various natural resources and man-made resources. Some of these commitments of resources are irretrievable by virtue of duration of commitment or cost. In other cases, commitments of resources are irreversible since the resource is consumed during IPM implementation.

4.15.1 Irretrievable Effects

Orchard Seed Production

An irretrievable effect on resources is the loss of seed production opportunities. Seed production would vary between alternatives, as would the costs associated with accomplishing environmentally sound pest management. The commitment of time and dollars are irretrievable when production is lost. However, they are not irreversible, since production levels can be reversed by changing orchard pest management strategies in the future.

Seed loss, primarily to insects and disease, would occur under all alternatives, but would have the potential to be highest under Alternative D (Non-Pesticide Pest Management).

Cost Efficiency

Lost efficiencies associated with not using an optimum mix of pest control methods would be irretrievable. Since Alternative A has the most flexibility for using all pest management methods, it should be the most cost-efficient.

4.15.2 Irreversible Effects

The principal irreversible commitment of resources associated with the proposed IPM methods is the use of fossil fuels from the operation of heavy equipment or power tools associated with mechanical methods or the equipment used in application of pesticides and fertilizers. Pest management approaches selected, the mix of which can vary widely even within a single alternative, would determine the level of fossil fuel consumption. For example, hand applications of pesticides and manual vegetation control methods would consume no fossil fuel during the treatment, while mowers or a tractor-mounted sprayer would.

5.0 Consultation and Coordination

Public involvement and interagency/intergovernmental coordination and consultation are recognized as an essential element in the development of an EIS. Public participation has been encouraged and solicited since the original "Notice of Intent to Prepare an EIS" was published in March 1999, and will continue through completion of the Final EIS. A scoping plan was developed in June 2002 when BLM initiated contractor support to complete the IPM EIS (BLM 2002). Agencies and interest groups with special expertise or concerns related to pest management have been notified of the project and advised of the need to coordinate information and provide input. Technical and scientific information available from a variety of sources has been reviewed and considered during the scoping process.

5.1 Scoping Process

Table 5.1-1 outlines a chronology of BLM's public outreach for the EIS scoping – starting March 26, 1999, when the first Notice of Intent was published in the *Federal Register*, through July 26, 2002, the official end of the public scoping period for the Draft EIS.

Table 5.1-1. Chronology of Scoping Activities

Date	Action
3/26/99	Notice of Intent published in *Federal Register* (one EIS for all four BLM western Oregon seed orchards)
3/31/99	Media news releases in the *Clackamas County News, Molalla Pioneer, Silverton Associated Press, The Oregonian, Statesman Journal* (Salem), *Capitol Press, Sandy Post,* and *Sandy Profile*
3/31/99	Congressional news release – Darlene Hooley's Salem Office; state legislative representatives; Clackamas County Commissioners
4/7/99	Request for comments published in *Illinois Valley News* in Cave Junction, OR
4/22/99	Open house announcement and fact sheet mailed
4/99	Community outreach – Area bulletin boards (flyer announcing open house): Colton Market; Colton Post Office; Colton Grade, Middle and High Schools; Springwater Store; Gerber Farm Supply; Estacada Public Library; Estacada Ranger District Office; Meadowbrook; Clarkes Grade School; Clarkes Grange 261; Clarkes Store
5/11/99	Open house at Horning Seed Orchard (5 attended)
3/29/01	Revised Notice of Intent in *Federal Register* (indicating decision to prepare three district-specific EISs)
7/1/02	Mailing to interested public advising of additional scoping period and revised EIS schedule (approximately 150 on mailing list)
7/1/02	Mailing to interested agencies advising of additional scoping period and revised EIS schedule (approximately 30 on mailing list for both orchards)
7/5/02	Second public scoping period begins
7/10/02	Public notice in local newspaper, *Molalla Pioneer*
7/10/02	Public notice in local newspaper, *Clackamas County News*
7/11/02	Public notice in Clackamas County edition of Portland newspaper, *The Oregonian*
7/26/02	Second public scoping period ends

5.2 Persons, Groups, and Agencies Consulted

BLM actively solicited scoping comments from the interested members of the general public, including adjacent and nearby landowners and other public citizens, public interest groups, industry and business, members of the media, libraries, and schools; and requested input from state and Federal officials (including tribal representatives), and Federal, state, and local environmental resource agencies. These persons and groups are identified in more detail in Section 5.3.

Numerous members of the public, representing nearby landowners, orchard cooperators, and public interest groups, as well as two agencies have responded to date. OWRD (Bill Fujii) commented during scoping regarding the need to coordinate with the State Watermaster if IPM activities would require additional water for agricultural, irrigation, or domestic use; and NOAA Fisheries (Dan Tonnes), at the invitation of BLM, conducted a site visit of the orchard on October 31, 2002, to meet with BLM orchard staff, and identify and discuss potential areas of concern for special status aquatic species. Formal consultation with NOAA Fisheries under Section 7 of the ESA was completed with issuance of a biological opinion by NOAA on December 21, 2004; see information summarized in Section 1.4.2 (see Appendix F for Biological Opinion). BLM consulted with ODFW in November 2002 regarding the presence of special status aquatic species within orchard boundaries. Finally, BLM contractors consulted with the EPA Office of Pesticide Programs and with manufacturers of pesticide products during performance of the risk assessment to request relevant information. Specifically, EPA provided agency-prepared documents that summarize technical studies relevant to the FIFRA registration of the pesticides and the current status of "other" ("inert") ingredients. Pesticide manufacturers provided material safety data sheets and product labels, as well as information on "other" ingredients.

5.3 Draft EIS Review and Comment

A detailed report of the public review and comment process on the Draft EIS is provided as Appendix E to this Final EIS. BLM received very few comments on the Draft EIS. No verbal comments were received during the public meetings and three written comments were received during the public comment period. The meeting attendees were BLM employees from the seed orchard and the Salem District office; they had no comments. Written comments were received from two Federal agencies and an individual representing herself and two organizations. Of the three commentors, one supported the selection of Alternative B (IPM with Environmental Protection Emphasis—the proposed action and preferred alternative), and one recommended that Alternative D (Non-Chemical Pest Management[1]) be selected. One commentor did not express any preference for a selected alternative, and limited comments to suggestions for changes to the details of Alternative B to further protect threatened salmonid species. A summary of the comments received is provided in Table 5.3-1. The comments and detailed responses are provided in Appendix E.

5.4 List of Agencies, Organizations, and Persons to Whom Copies of the Statement are Sent

The current mailing list includes 188 names, 159 of which are members of the general public, including adjacent and nearby landowners and other public citizens, public interest groups, industry and business, members of the media, libraries, schools, and state and Federal officials (including tribal representatives); and 29 of which represent Federal, state, and local environmental resource agencies. A breakdown of the state, Federal, and local environmental resource agencies, tribal contacts, and public interest groups is provided.

[1] Revised to be named Non-Pesticide Pest Management for Final EIS in response to comment T5-2.

Table 5.3-1. Summary of Public Comments on Draft EIS

Tracking Number	Commentor	Format and Date	Focus
H1	Michael P. Tehan National Marine Fisheries Service (NOAA Fisheries) National Oceanic and Atmospheric Administration Portland, OR	Letter dated 8/13/03, received 8/20/03	Suggestions for additional analysis, monitoring, and protection measures for anadromous fish species
H2	Judith Leckrone Lee Manager, Geographic Unit Region 10, U.S. Environmental Protection Agency Seattle, WA	Faxed letter dated 9/10/03, received 9/10/03	Support for Alternative B, pesticide safety, IPM for specific diseases, additional technologies, Port-Orford-Cedar management, pesticides listed in a recent Western District Court decision
H3	Jan Wroncy Individually and representing Coast Range Guardians and Canaries Who Sing Eugene, OR	Letter dated 8/25/03, faxed 8/27/03	Support for Alternative D, opposition to use of pesticides, request to exclude *B.t.* from Alternative D, statement that impacts from pesticides are underestimated and would affect salmon, recommended no use of fertilizers to decrease need for pesticides

Agency List (27)

City of Estacada
City of Oregon City
City of Oregon City, Parks Department
Colton Water District
South Fork Water Board
Clackamas County Forester
Clackamas County Board of Commissioners
Clackamas County Extension Service
Oregon Department of Agriculture
Oregon Department of Environmental Quality
Oregon Department of Fish and Wildlife – Clackamas Fish Hatchery
Oregon Department of Fish and Wildlife, Planning and Coordination (NW Region)
Oregon Department of Fish and Wildlife (2)
Oregon Department of Forestry (2)
Oregon Department of Forestry, Clackamas-Marion District
Oregon Department of Land Conservation
Oregon Department of Water Resources
Deputy State Historic Preservation Officer
National Marine Fisheries Service
U.S. Department of Agriculture, APHIS Wildlife Services
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Fish and Wildlife Service, Eagle Cr. Nat. Fish Hatchery
U.S. Forest Service, Willamette National Forest
U.S. Forest Service, Regional Forester
U.S. Forest Service, Mt. Hood National Forest HQ
U.S. Forest Service, Clackamas River Ranger District

Public Interest Groups (46)

1000 Friends of Oregon
Associated Oregon Loggers, Inc.
Canaries Who Sing
Canby Utility Board
Cascadia Forest Alliance
Coast Range Guardians
Estacada Chamber of Commerce
Clackamas River Basin Council
Clackamas River Water
Defenders of Wildlife
Department of Veterans Affairs (Canada)
Friends of Clackamas
Izaak Walton League of America
Molalla Area Chamber of Commerce
Molalla River Watch
Molalla Timber Action Committee
Molalla Saddle Club
M-TAC
Native Plant Society of Oregon
Northwest Christmas Tree Growers Association
Northwest Coalition for Alternatives to Pesticides
Northwest Forestry Association
Northwest Steelheaders
NW Environmental Defense Center
NW Ecology Center
Oregon Environmental Council
Oregon Equestrian Trails
Oregon Farm Bureau Federation
Oregon Forest Industries Council
Oregon Forest Resources Institute
Oregon Natural Resources Council
Oregon Public Broadcasting
Oregon Trout
Oregon Water Trust
Oregon Wildlife Federation
Oregonians for Food and Shelter
OSPIRG
Pacific Rivers Council
Portland Audubon Society
Rivers Network
Sierra Club
Society of American Foresters
The Harness and Pleasure Driving Association
The Nature Conservancy
Western Wildlife Sports, Association
Western Wood Products Association

Government Officials (11)

Confederated Tribes of Warm Springs (2)
Governor's Federal Forest & Resource Policy Team
Governor's Forest Planning Team
Honorable Darlene Hooley, U.S. House of Representatives
Rep. Earl Blumenauer
Rep. Jan Lee
Sen. Roger Beyer
Sen. Gordon Smith
Sen. Marylin Shannon, District 15
Sen. Ron Wyden
Sen. Rick Metsger

6.0 List of Preparers

BLM Staff (Horning Seed Orchard, Salem District Office, Oregon State Office)

Name	Primary Responsibility	Discipline	Related Professional Experience
Jeannette Griese	Contracting officer's representative State coordinator	Forestry	14 years BLM forester/ silviculturist
Greg Tyler	Horning Seed Orchard manager	Forestry	15 years forestry-related roles (BLM and Forest Service)
Arlene Roux	Alternate contracting officer's representative	Seed orchard and botany	11 years BLM
Bob Ruediger	Fisheries Alternate contracting officer's representative ESA Section 7 consultation (fish)	Fisheries	16 years BLM 5 years Forest Service
Chester Novak	Water resources Water quality monitoring Soils	Hydrology and soils	13 years BLM hydrologist 10 years BLM soil scientist
Roy Price	Terrestrial wildlife and habitat	Wildlife management	27 years BLM wildlife biologist
Terry R. Garren	Horticulturalist Contributor	Horticulture	25 years BLM horticulturalist 5 years Weyerhaeuser tree breeding supervisor 1 year commercial pesticide applicator 5 years laboratory analysis and biological technician (Oregon State University)
Paul Jeske	Salem District NEPA, Planning	NEPA and planning	20+ years BLM multi-resource staff and supervisory roles
Claire Hibler	Botany	Botany and weeds	14 years BLM botanist/forester
Fran Philipek	Cultural resources	Archaeology	25 years BLM and Forest Service
Leslie Frewing-Runyon	Oregon State Office NEPA	Planning and economics	14 years BLM regional economist/ planner

Contract Staff (LABAT-ANDERSON INCORPORATED and Subcontractors)

Name	Primary Responsibility	Discipline	Related Professional Experience
Christine Modovsky	Project manager Alternatives Human health Ecological impacts Risk assessment	Environmental chemistry and risk assessment	15 years risk assessment and NEPA analysis/ compliance (LABAT, EPA, Dept. of Interior)
Kristin Sutherlin	Deputy project manager Socioeconomics and environmental justice Land use Noise Public involvement	Planning and economics	16 years socioeconomics and NEPA analysis/compliance (LABAT, USDA APHIS, University of Maryland)
Susan Smillie	NEPA compliance Public involvement Water resources	Environmental engineering and biology	22 years NEPA analysis/compliance and impact assessment (LABAT, Morrison-Knudsen, Battelle)
Randy McCart	Soils GIS mapping Air quality	Geography	14 years NEPA compliance and impact assessment (LABAT)
John Weeks	Environmental fate modeling Risk assessment	Forestry, biostatistics, biology, and toxicology	23 years fate and transport modeling, risk assessment (SC Johnson, LABAT, Ketron, Environmental Research Associates, Forest Service)
Dr. Jason Sandahl	Aquatic species impacts	Aquatic toxicology	12 years pesticide management and impacts, science research and education, forestry (Oregon State University, Forest Service, Peace Corps)
Dr. William Liss	Aquatic species impacts	Salmonid ecology	26 years science research and education (Oregon State University)
Dr. Jesse Ford	Impact assessment	Ecology	23 years science research and education (Oregon State University, University of Alaska, NCASI, Cornell University, North Shore Consultants, University of Minnesota, Minnesota DNR)
Jody Nelson	Vegetation impacts IPM methods	Botany	12 years ecological impact assessment, science education (LABAT, Denver Botanic Gardens, University of Northern Colorado)
Karin Keifer	Terrestrial wildlife	Biology and animal behavior	4 years ecological impact assessment, research, animal husbandry (LABAT, Sevilleta National Wildlife Refuge, Dallas Zoo, Tantra National Park -Slovakia, Franklin and Marshall College)
Quinn Damgaard	General research and support Cultural resources Aquatic species	Biology	2 years technical writing, lab analysis, vegetation management, public outreach (LABAT, Midwest Laboratories, Pottawattamie County Conservation Board)
Dean Converse	General research and support Air quality	Geography and environmental studies	3 years air quality, environmental analysis (LABAT, Nebraska DEQ)

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Acronyms and Abbreviations

°F	degrees Fahrenheit
$\mu g/L$	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
μm	micron, micrometer
a.i.	active ingredient
AQCR	air quality control region
BLM	Bureau of Land Management
BMP	best management practice
B.t.	*Bacillus thuringiensis*
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CO	carbon monoxide
CX	categorical exclusion (under NEPA)
dB	decibel
dBA	"A-weighted" decibel
EA	environmental assessment
EFH	essential fish habitat
EIS	environmental impact statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	*Endangered Species Act*
ESU	evolutionarily significant unit
EXAMS	Exposure Analysis Modeling System
FIFRA	*Federal Insecticide, Fungicide, and Rodenticide Act*
FLPMA	*Federal Land Policy and Management Act*
FONSI	finding of no significant impact
ft	foot or feet
ft^2	square feet
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
GA 4/7	gibberellic acid
gal	gallon
GLEAMS	Groundwater Loading Effects of Agricultural Management Systems
in	inch or inches
IPM	integrated pest management
kg	kilogram
lb	pound(s)
LC_{50}	median lethal concentration
LD_{50}	median lethal dose
L_{eq}	equivalent sound level
MATC	maximum acceptable toxicant concentration
mg	milligram

mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
min	minute
MSA	metropolitan statistical area
Mt.	Mount
NA	not applicable / not available
NAAQS	National Ambient Air Quality Standards
NEPA	*National Environmental Policy Act*
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NO_2	nitrogen dioxide
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NWSOMA	Northwest Seed Orchard Managers Association
O_3	ozone
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
OWRD	Oregon Water Resources Department
oz.	ounce
PAH	polynuclear aromatic hydrocarbon
Pb	lead
PCI	per capita income
PM	particulate matter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PM_{10}	particulate matter less than 10 microns in diameter
ppm	parts per million
Q	quotient
RfD	reference dose
RMP	resource management plan
ROD	record of decision
ROI	region of influence
SDWA	*Safe Drinking Water Act*
SEIS	supplemental environmental impact statement
SHPO	State Historic Preservation Officer
SO_2	sulfur dioxide
SWAP	source water assessment program
TMDL	total maximum daily load
TPI	total personal income
UIC	underground injection control
URL	uniform resource locator (web site address)
USBC	U.S. Bureau of the Census
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

Glossary

Note: All definitions are specific to their use in this environmental impact statement. Additional terms specific to the recently conducted risk assessment are found in Section 10 of the risk assessment report.

Acaricide. An insecticide that specifically targets mites and ticks.

Active ingredient. The pesticidally active chemical contained in a pesticide product.

Acute. Single-dose toxicity study. May also refer to adverse effects that exhibit a short and relatively severe course.

Adsorption. Adhesion of substances to the surfaces of solids or liquids; technically, the attraction of ions of compounds to the surfaces of solids or liquids.

Anadromous. Fish that are born in fresh water, migrate to the ocean to grow into adults, and then return to fresh water to spawn.

Analysis. The second step of an ecological risk assessment, which examines the two primary components of risk–exposure and effects–and the relationships between each other and ecosystem characteristics.

Biological control. The use of natural enemies to attack a target plant, insect, or animal pest.

Boom. A tubular metal device that conducts a pesticide or fertilizer mixture from a tank to a series of spray nozzles. A boom may be mounted beneath an aircraft or behind a vehicle.

Broadcast application. The applying of pesticide or fertilizer over an entire area or field rather than only to rows, beds, or individual plants.

Buffer (strip or zone). A zone left untreated with pesticide or fertilizer (at the outer edge of a treated area or along streams) as protection against the effects of treatment.

Cancer slope factor. Represents the probability that a 1-mg/kg/day chronic dose of a chemical will result in formation of a tumor. Expressed as a probability, in units of "per mg/kg/day" or $(mg/kg/day)^{-1}$.

Canopy. The uppermost level of a forest community, usually formed by the tallest trees.

Carcinogen. A substance producing or inciting cancer.

Categorical exclusion. A category of actions that do not individually or cumulatively have significant effects on the human environment and for which neither an environmental assessment nor an environmental impact statement is required.

Cation exchange capacity. The capacity of a soil to adsorb cations (positively charged ions), expressed in milliequivalents per 100 grams of soil.

Chemical degradation. The breakdown of a chemical substance into simpler components through chemical reactions.

Chemigation. The injection of pesticides and fertilizers through irrigation systems.

Chronic. Long-term, usually lifetime or near lifetime in duration.

Clonal orchard. A production unit consisting of plants that are genetically identical to the parent plant; they are produced asexually, e.g., from cuttings or suckers.

Control. Reduction of a pest problem to a point where it is below an acceptable threshold.

Critical habitat. (1) Specific areas within the habitat occupied by a species at the time it is listed under the *Endangered Species Act* where there are physical or biological features (i) essential to the conservation of the species and (ii) that may require special management considerations or protection, and (2) specific areas outside the habitat occupied by the species at the time it is listed upon the determination by the Secretary of the Interior that such areas are essential for the conservation of the species.

Cultural resources. Remains of human activity, occupation, or endeavor, reflected in districts, sites, structures, building, objects, artifacts, ruins, works of art, architecture, and natural features that were of importance in past human events. Cultural resources consist of (1) physical remains, (2) areas where significant human events occurred, even though evidence of the events no longer remains, and (3) the environment immediately surrounding the actual resource.

Cumulative impact. The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time

Dose. The amount of chemical entering the body.

Drift. The movement of airborne particles by air motion (wind) away from an intended target area.

Endangered species. Plant or animal species that are in danger of extinction throughout all or a significant part of their range.

Environmental assessment. A systematic environmental analysis of site-specific activities used to determine whether such activities would significantly affect the human environment, and whether an environmental impact statement is required.

Environmental impact statement. An analytical document developed for use by decisionmakers to weigh the environmental consequences of a potential action.

Ephemeral stream. A stream that flows only in direct response to precipitation and whose channel is at all times above the water table.

Exotic plants. Plants that are not native to the region in which they occur.

Exposure assessment. The second step in human health risk assessment, involving estimation of doses from various scenarios and routes of exposure.

Fertilizer. Any of a large number of natural or synthetic materials, including manure and nitrogen, phosphorus, and potassium compounds, spread on or worked into the soil to increase its fertility. General fertilization refers to application of fertilizer to entire orchard units, in contrast to calcium nitrate application to specific trees for cone stimulation.

Forb. A low-growing herbaceous plant that is not a grass, sedge, or rush.

Formulation. A specific composition of pesticide active ingredient(s) and other ingredients, comprising a pesticide product.

Girdling. A physical cutting or disruption of the cambial sap flow within a tree.

GLEAMS. Groundwater Loading Effects of Agricultural Management Systems, a computer-based model for predicting the fate and transport of agricultural pesticides and fertilizers.

Ground cover. Grasses or other plants that keep soil from being blown or washed away.

Habitat. The environment in which an organism occurs.

Half-life. The time required for a chemical to degrade to 50% of its original concentration.

Hazard assessment. The first step in human health risk assessment, in which each chemical's toxic properties and dose-response relationship are identified.

Hazard index. An indicator of risk to human health, representing the ratio of the estimated dose to the reference dose. A hazard index of 1 or less usually indicates negligible risk to human health.

Infiltration. The downward or lateral entry of water into the soil.

Integrated pest management. Use of several techniques (for example, burning, grazing and mechanical, manual, or chemical methods) as one system to control pests where they are unwanted. IPM means responding to pest problems with the most effective, least-risk option. Under IPM, actions are taken to control pests only when their numbers are likely to exceed acceptable levels and to limit the impact on other organisms and the environment.

Intermittent stream. A stream that flows only at certain times of the year when it receives water from winter rain or melting snow.

LC_{50}. The concentration of a chemical in water at which 50 percent of test animals were killed. It is usually used in testing of fish or other aquatic animals.

LD_{50}. The dosage of toxicant (expressed in milligrams of toxicant per kilogram of animal body weight) required to kill 50 percent of the animals in a test population.

Leaching. The movement of chemicals through soil by water.

Lowest-observed-effect concentration. The lowest chemical concentration in water at which adverse effects are observed in an aquatic toxicity study.

Maximum acceptable toxicant concentration. The geometric mean of a no-observable-effect concentration and a lowest-observed-effect concentration.

Mean. The average of a set of values.

Median. The middle value in a ranked distribution.

mg/kg. Milligrams per kilogram, usually indicating a dose level in terms of milligrams intake of a substance per kilogram of body weight.

mg/kg/day. Milligrams per kilogram per day, usually indicating a daily dose level in terms of milligrams intake of a substance per kilogram of body weight per day.

mg/L. Milligrams per liter, usually indicating a concentration of a substance in water.

No-observed-effect concentration. The highest water concentration at which no adverse effects are observed in an aquatic toxicity study.

Noxious weed. According to the *Federal Noxious Weed Act* (FL 93-629), a weed that causes disease or has other adverse effects on man or his environment and therefore is detrimental to the agriculture and commerce of the United States and to the public health.

Perennial stream. A stream that flows continuously year round.

Pesticide. Any substance or mixture of substances intended for controlling insects, rodents, fungi, weeds, or other plants and animals that are considered pests.

Phytophagous. An organism that feeds on plants, particularly an insect that feeds on shrubs or trees.

Prescribed burning (prescribed fire). The scientific, intentional burning of wildland fuels in either their natural or modified states under conditions to allow the fire to continue to a predetermined area and to produce the intensity of heat and rate of spread needed to meet certain objectives.

Problem formulation. The first step in an ecological risk assessment, in which the purpose of the assessment is provided, the problem is defined, and a plan for analyzing and characterizing risk is determined.

Raptors. Birds of prey, such as owls, hawks, or eagles.

Receptor. An ecological entity that is exposed to a stressor.

Reference dose. An estimate of the highest possible daily dose of a chemical that will pose no appreciable risk of deleterious effects to a human during his or her lifetime.

Riparian. Pertaining to or located along a stream bank or other water bodies, such as ponds, lakes, reservoirs, or marshes.

Risk characterization. The third step in both human health and ecological risk assessment, in which estimated doses are compared to a chemical's toxic properties to predict the potential for adverse effects under the given conditions of exposure.

Risk. The probability that a substance will produce harm under specified conditions.

Rogue. To systematically cut and remove individual trees and/or families considered no longer desirable within the seed orchard population. Roguing is used to increase genetic gain potential in an orchard. Theoretically, the more intensive the roguing, the greater the genetic improvement.

Runoff. The part of the precipitation in a drainage area that is discharged from the area in stream channels, including surface runoff, ground water runoff, and seepage.

Scoping. The process by which significant issues relating to a proposal are identified for environmental analysis. Scoping includes eliciting public comment on the proposal, evaluating concerns, and developing alternatives for consideration.

Soil compaction. The compression of the soil profile from surface pressure, resulting in reduced air space, lower water-holding capacity, and decreased plant root penetrability.

Sorption. The process of taking up or holding by either absorption or adsorption.

Special status species. Species which are proposed for listing, officially listed as threatened or endangered, or are candidates for listing as threatened or endangered under the provisions of the *Endangered Species Act*; those listed by a state in a category such as threatened or endangered implying potential endangerment or extinction; and those designated by each BLM State Director as sensitive.

Spot treatment. Applying pesticide to a selected individual area (as opposed to broadcast application).

Stressor. Any physical, chemical, or biological entity that can induce an adverse response.

Threatened species. A plant or animal species that is not in danger of extinction but is likely to become so within the foreseeable future throughout all or a significant portion of its range.

Trade name. The commercial name of a pesticide product.

Water table. The upper limit of the part of the soil or underlying rock material that is wholly saturated with water.

Weed. A plant out of place or growing where not desired.

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Appendix A: Seed Orchard Pests

This appendix provides detailed information on the more common and damaging insects and diseases at the Horning Seed Orchard; information on weeds and animal pests is provided in Chapter 1. It is not intended to be a complete guide to orchard insects and diseases in the Pacific Northwest Region.

Insects

Cone gall midge (*Contarinia oregonensis*)
Adults are flies 3-4 mm in length, which emerge in early spring. The females lay eggs near the base of the cone scale in newly opened flowers. When the egg hatches, the larva tunnels into the young cone scale and forms a gall. When the mature cones become wet in the fall, the larvae drop to the litter and pupate. Cocoons are spun in the litter, and overwintering occurs in prepupal and pupal stages. Seeds may be fused to the scale when only a few larvae are present or completely destroyed when numbers are large. This insect can be a major destroyer of Douglas-fir seeds; severe infestations can destroy all seeds in the cone.

Fir coneworm (*Dioryctria abietivorella*)
As a group, coneworms are one of the most important North American lepidopterous cone pests. Life cycles and preferred hosts vary between species of coneworms. White fir, Douglas-fir, ponderosa pine, and sugar pine cones may be attacked. The adults are moderate-sized, drab-colored moths with mouth parts that are somewhat snout-like. Larvae can bore into the cambium of the trunk, branches, and shoots or into fresh green cones. The larva feeds voraciously, tunneling indiscriminately through the scales and seeds. One larva can destroy an entire cone. A heavy infestation can destroy 100% of a Douglas-fir cone (and seed) crop.

Cone moth (*Barbara colfaxiana*)
Adult cone moths are grayish brown in color with forewings transversely banded with gray, silver, and brown. The moth emerges in spring and the female lays eggs on the cone bract. The larva feeds first in scale tissue, but soon moves to the central seed-producing portion of the cone, where it mainly feeds on seeds. By the end of July, they pupate in a tough pitch-coated cocoon in the center of the cone. Feeding tunnels around the cone axis sharply reduce seed production. External evidence of damage differs depending on cone size. This insect is one of the major pests of Douglas-fir cones. One larva may destroy up to 60% of the seeds in a cone. Pupae may remain in diapause for one to three years in the old cones after they have fallen from the trees.

Western conifer seed bug (*Leptoglossus occidentalis*)
The broad flat tibia of the hind legs characterizes the western conifer seed bug, also called the leaf-footed bug. It feeds upon and damages the seed of Douglas-fir, sugar pine, and ponderosa pine. The adults are 15 to 18 mm long, and are reddish brown to dark gray with dense whitish pubescence. The seed bug overwinters in the adult stage and emerges in May or June; there is one generation per year. The eggs are deposited in rows on the needles from June until mid-August. Seed bug nymphs feed in the ovules and can cause conelet abortion. Later nymphal instars and adults feed on seeds. No external damage is visible on the cones. Both adult and nymph stages insert their long proboscises into cones to suck juices from the seeds, while the bug remains on outside of cone. Feeding by this insect lowers the quality of the seed crop, and heavy feeding can cause up to 40% loss in Douglas-fir seed crop.

Seed chalcid (*Megastigmus* spp.)
The species of this genus include pests of a wide range of conifers. All species are highly specialized in their method of attack and feeding habits. Several species are found attacking Douglas-fir and true fir; however, only one species is known to attack pine (*M. albifrons*). The adults are small antlike wasps, which may be black to brown, or yellowish in color. The females are larger (about 4.0 mm long) with a long curved ovipositor. Eggs are deposited into immature seeds. Larvae feed only on seed contents, each one destroying a single seed. After devouring the contents, it remains within the seed coat. There is no external evidence of damage on the seeds until the adult emerges, after which a clearly defined emergence hole is evident. Larvae remain over winter in the seeds, either in the cone or in the litter under the trees in the orchard. It pupates in the spring.

Bark beetles and wood borers
A variety of small, dark-colored, winged beetles bore into standing green trees or downed slash material, or lay eggs on the bark surface of standing green trees or dead and downed trees. These damaging forest insects are ubiquitous throughout the forest, are specific to host trees, and maintain fairly consistent populations during normal conditions, but increase significantly during stressful events or conditions. Under normal circumstances, vigorous, healthy trees have unique capabilities to resist beetle attack. However, under adverse conditions such as disease infection, heat and drought damage, mechanical damage, high water tables, nutrient deficiencies, or a variety of other stress-related tree conditions, the insect populations increase and infest weak trees, as well as healthy nearby trees.

An adult insect generally emerges in spring from a tree infested the previous year and flies to a susceptible green tree, where it excavates an egg gallery in the fresh phloem tissue. When the eggs hatch, the larvae bore away from the egg gallery and construct a mine that gradually increases in length and width. The pattern of adult and larval mines is distinctive for each insect species. The larvae pupate in the wood and overwinter as pupae or adults. Some species produce more than one generation in a year.

The trees are killed by fungi introduced into the tree by beetles feeding and boring in the phloem tissue, and the fungi expanding into the xylem tissue, obstructing the transport of water to the tree crown. The beetle galleries themselves also can become so numerous that the tree is girdled by insect activity.

Disease

***Armillaria* root rot (*Armillaria* spp.)**
Armillaria root disease is the most common and most widely distributed forest root disease in Oregon and Washington. It is often found affecting trees that have been weakened by other agents, particularly drought or poorly drained soils. Symptoms of *Armillaria* root disease include thin and/or chlorotic foliage; distress cone crops; abundant resin flow, or leaching of brown liquid at tree bases; a yellow-stringy root and butt rot; and tree mortality. Crown and root collar symptoms occur on only 15-20% of the living infected trees with disease centers; infection in the remaining trees is virtually undetectable. Virtually all trees and other woody species in Oregon and Washington can be damaged by *Armillaria* root disease. It can locally be very severe in southwestern Oregon. In general, white fir is the most susceptible. Mortality caused by the disease is most common in Douglas-fir plantations between the ages of 10 and 25. Tree death after age 25 is uncommon unless the trees are stressed. The disease in Douglas-fir is often associated with poor planting technique, use of planting stock that is not adapted to a particular site, wounding, inadequate drainage, or soil compaction. Affected trees can be windthrown but tend to die standing. Tree death by the disease will often increase one to two years after severe droughts or nearly complete defoliation by insects. Spread of the disease from infected stumps or trees to adjacent healthy trees occurs mainly by mycelia

growing across root contacts and, to a lesser extent, by rhyzomorphs that form after a stump or large root system has been colonized. Once a root is infected, the fungus can spread distally and proximally within it.

Annosus root rot (*Fomes annosus*)
Annosus root rot is caused by the fungus *Fomes annosus* and occurs throughout the Pacific Northwest. Estimates of losses caused by this disease have not been made for Oregon and Washington, but it is believed to be the third most damaging root disease in the two states after laminated root rot and *Armillaria* root disease. Losses due to annosus root disease are known to be increasing. All conifers can be affected, but there are differences among species in degree of susceptibility and damage. In the Pacific Northwest, western hemlock, mountain hemlock, grand fir, white fir, and Pacific silver fir are highly susceptible and can be severely damaged. Douglas-fir, western redcedar, incense cedar, Port-Orford-cedar, western larch, western white pine, sugar pine, Engelmann spruce, and Sitka spruce are slightly susceptible and rarely damaged. Pines in southwestern Oregon are rarely affected.

This disease is more difficult to identify than are other common root diseases. It causes variable symptoms. Some hosts, especially true firs, frequently die without showing crown symptoms. Other hosts, particularly pines, exhibit decreased terminal growth, needle yellowing, and crown decline prior to death. The disease infects its hosts in two ways: by windblown spores depositing and germinating on freshly exposed wood, and by mycelial growth from diseased roots to healthy roots via contacts. The disease causes two kinds of damage: tree mortality and wood loss through decay. Tree death is the usual result of infection in resinous hosts. Trees killed by the disease tend to die standing rather than be windthrown. Mountain pine beetles and western pine beetles often attack infected pines, and attacks by fir engraver are common on infected true firs.

Laminated root rot (*Phellinus weirii*)
Laminated root rot is caused by the fungus *Phellinus weirii*. It is the most damaging root disease in the Pacific Northwest, estimated to cause annual losses of 32 million cubic feet of wood in western Oregon and Washington. Douglas-fir, mountain hemlock, white fir, and grand fir are especially susceptible; pines and cedars are considered to be tolerant or resistant and are seldom infected and killed. Crown symptoms of affected trees include retarded leader growth; short, sparse, and chlorotic faded foliage; and distress cone crops. Crown symptoms are usually not seen until at least half of the host root system is affected. Only about half the infected trees in a disease center will have crown symptoms. Laminated root rot extensively decays roots of highly susceptible host trees and either causes windthrow or kills the trees by destroying their ability to take up water and nutrients. Infected saplings and small poles usually die standing; larger trees are more likely to be windthrown. Infected trees may suffer growth loss for several years prior to death. Laminated root rot often predisposes highly susceptible hosts to bark beetle. Spreading of the disease is all by mycelia on or within the roots. The fungus can persist from tree generation to generation in infested areas and can be considered a disease of the site. It can survive up to 50 years in large roots and stumps of dead or cut trees, and can infect trees that become established nearby by growing across root contacts. This disease is found mostly in forested areas with a site history of occurrence, and likely not to be found in non-forest conditions.

***Phytophthora* root rot (*Phytophthora* spp.)**
Hosts include a range of conifer species, primarily Douglas-fir and true fir. Infection by *Phytophthora* species results in decay and loss of roots. Depending on the degree of infection, seedlings may be killed, stunted, or show no above-ground symptoms. Because the fungus needs high soil moisture to sporulate and infect, the disease is most common in low, poorly drained areas. In these wet areas, 100 percent of seedlings may be killed or culled, although usually less than 1% of a crop is lost to *Phytophthora*.

Black stain root rot (*Leptographium wageneri*)
This disease can be found in most parts of Oregon and Washington, but is far more common west of the Cascade Range. It tends to be most widely distributed and most damaging in southwest Oregon. Black stain is a vascular wilt-type disease rather than a true root rot, colonizing the water-conducting tissues of the roots, root collars, and lower stems, ultimately blocking the movement of water to the foliage. Infected trees experience severe moisture stress, decline rapidly and die. Often, disease-weakened trees are infested by bark beetles and woodborers at the root crown area. Black stain causes crown symptoms similar to those of other conifer root diseases, including sudden reduction of terminal growth, partial loss of older needles, foliage chlorosis, and production of distress cone crops. Douglas-fir is the most common host of black stain in the Pacific Northwest, where centers of black stain root disease usually are found in 15-25 year old plantations or in heavily stocked patches of natural regeneration. It is believed that Douglas-fir over 30 years old develop substantial resistance to the disease. With other hosts, the disease affects trees of all ages in relatively pure stands. Long-distance spread of the fungus involves insect vectors, predominantly root-feeding bark beetles (*Hylastes nigrinus*) and weevils (*Steremnius carinatus* and *Pissodes fasciatus*).

***Phomopsis* canker (*Phomopsis lokoyae*)** Infection of two-year-old stem tissue occurs early in the second growing season, resulting in a canker at the base of the new growth, which girdles the stem. The part of the shoot above the canker is killed. The disease appears periodically in the Pacific Northwest, typically 1 or 2 years after droughts. It is associated with prolonged periods of warm weather during budburst. Douglas-fir is most susceptible to this pest.

***Rhabdocline* needlecast (*Rhabdocline pseudotsugae*)**
Rhabdocline needlecast is occasionally common, but seldom damaging in Douglas-fir stands. Yellow and purple blotches appear on infected needles in the fall and following spring. Needles drop one year after infection. Purplish-pink fruit bodies break through the undersides of one-year-old needles in May to June, exposing orange-brown spores. Spores released from them are windborne and require considerable moisture to germinate. Only the current season's needles are susceptible. There is considerable variation in the susceptibility of Douglas-fir to this disease. In general, coastal Douglas-fir is less susceptible than the inter-mountain variety, and local seed source stock is less susceptible than offsite stock. However, trees within any stand show different levels of infection (many are immune). Disease is most common on trees 5-30 years old.

Swiss needlecast (*Phaeocryptopus gaumanni*).
This disease is very common in western Oregon and Washington. Damage is seldom serious in forest stands, but is probably the most important disease in Christmas tree plantations. Only Douglas-fir is attacked. Infected needles are killed and shed. Growth loss may result on severely infected trees. It has become an increasingly important concern as a threat to Douglas-fir in the Oregon Coast Range and western Cascades. For the past several years, Swiss needlecast has been especially damaging in stands within 30 miles of the Oregon coast north from Coos Bay. Affected trees exhibit yellowing and browning of infected previous year's needles in spring shortly after current needles emerge. One-and two-year-old needles are lost in summer, with needle loss beginning in the bottom of the crown and progressing upward. Severely infected trees may have only current season's needles in the fall. The disease cycle begins in spring when spores are released from fruiting bodies on older diseased needles. Spores are carried on air currents to newly emerged needles. When adequate moisture is present, the spores germinate and the fungus penetrates the needle. Needles are only susceptible for a few weeks after emergence. The fungus ramifies through the needles and, eventually, the fruiting bodies form in the stomata in the fall and winter and mature in the spring.

Douglas-fir rust (*Melampsora occidentalis*)
Native *Melampsora* rusts attack a wide variety of conifer hosts that belong to a number of different genera, including Douglas-fir (one of the primary hosts). *Melampsora* rusts attack the foliage of young primary hosts, most severely in the regeneration and sapling stages. The infected needles are killed and, in years of severe infections, all current year's foliage may be eliminated, resulting in growth reduction. Occasionally, cone scales are attacked, but no damage to seed occurs as happens with cone rusts. All foliage rusts cause yellow to orange discoloration or spots on the foliage of their hosts. For *M. medusae* and *M. occidentalis*, host alternation appears to be obligatory; that is, the presence and proximity of both poplars and conifers is necessary for the rust's survival. Basidiospores from secondary hosts infect the new foliage of the primary hosts in spring, and aecia begin to appear on the primary hosts approximately two weeks after infection. The aeciospores infect the secondary hosts during the summer, and uredinia begin to appear on them approximately two weeks after infection. Uredeniospores spread and intensify the rust on its secondary hosts. Toward fall, telia, instead of uredinia develop on the secondary hosts. They overwinter in a state of dormancy in dead leaves on the ground and germinate the following spring, at a time when young shoots of the primary hosts begin to break forth from their buds.

Storage molds (including *Botrytis cinerea*, *Pythium* spp. and *Phytophthora* spp.)
Storage molds in greenhouse seedlings are caused by a wide variety of soil and fungi which enter the storage bag via the soil or on the roots or foliage of the packed seedlings. Under favorable conditions, before, during, or after storage, these fungi move from the soil or organic debris in the bag, into healthy seedling tissue, and cause destruction of part or all of the seedling. Fungi such as *Pythium* and *Phytophthora* can infect the lower stem and roots, and cause root death. *Botrytis cinerea,* cause of gray mold in the field, can also infect foliage and stem tissue in storage, causing needle or branch death. Storage molds occur sporadically; their occurrence depends upon environmental conditions before, during, and after storage, the physiological condition of the seedlings, and the abundance of inoculum on the seedling or in the soil adhering to the rots.

Gray mold (*Botrytis cinerea*)
Many conifer species, Douglas-fir, and redwoods are very susceptible to this pest. Gray mold infects and kills needles, branches, or stems. Gray mold occurs at varying levels, primarily in Douglas-fir crops during the second year. Gray mold occurs both in the field and in storage. In the field, the disease is most prevalent after the canopies of the seedlings have closed, usually in the second or third year, and during cool, wet seasons. Beneath the canopy, an ideal environment exists for the development of gray mold – abundant moisture and the presence of dead or senescing plant material, which the fungus grows on. The fungus is also a problem in greenhouses where high humidity and favorable temperatures increase the potential for outbreaks.

Damping-off (*Pythium* and *Fusarium* spp.)
Pythium and *Fusarium* are found in the soil, or can be present on the seeds themselves. They can affect a wide variety of plants, including most conifers. Damage includes poor germination or death of seedlings shortly after emergence. Damping-off is common and usually results in losses up of 5 to 10% in some seedlots which may, on occasion, be much higher.

***Lophodermium* needle cast (*Lophodermium seditiosum* and others)**
Needles of infected pines develop brown to black spots on the needles in the late summer and fall of the first year of infection. These needles turn completely brown and are cast the following spring. Heavily infected seedlings can be killed by the fungus.

***Fusarium* root disease (*Fusarium* spp.)**
Fusarium root disease (hypocotyls rot) infects the roots; this may or may not result in death of the seedling, depending on the extent of decay in the root system. *Fusarium*

hypocotyls rot involves the infection and decay of the hypocotyls tissue at the ground line, so that the seedling is girdled and killed. Losses in various seedlots range from 0 to 30%. *Fusarium* root rot is less common in nurseries which routinely fumigate their soil prior to sowing. Common hosts include Douglas-fir, ponderosa pine, and true firs.

Leaf spots and blights (various fungal species)
Infected leaves show spots and blotches, function poorly, and die early. Heavy infections cause stunting. Hardwoods serve as hosts and conditions favoring pests include high seedling densities, high humidity, and wet foliage.

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Appendix B: Monitoring Plan

B.1 Water Quality Monitoring

B.1.1 Goal

The goal of the water quality monitoring plan is to ensure water quality is protected during and after IPM activities.

B.1.2 Background

Agencies and the public are concerned that pesticide and fertilizer application at Horning may enter streams and groundwater, contributing to concentrations that exceed those known to impact human and aquatic life. Special status salmonid species occur in direct proximity to actively managed orchard units, and the seasonal groundwater table is a concern in terms of greenhouse effluent management.

The Human Health and Non-Target Species Risk Assessment for Pest Management at Horning Seed Orchard indicates the use of pesticides and fertilizers poses minimal threat to water quality with one possible exception: runoff of ammonia if maximum scenario fertilization rates were used.

Water quality monitoring of an aerial esfenvalerate application during the spring of 2001 documented that introduction of drift is possible despite implementation of protective measures. 2002 monitoring of a similar spray project documented control of drift through implementing additional stream-specific protective measures. During both periods of monitoring, surface runoff from the orchard units in Section 13 was found to be an insignificant pathway for esfenvalerate transport, as almost all actual and potential rainfall infiltrates the soil surface. No concentrations of esfenvalerate were recorded in stream flow samples during peak storm flow periods. This monitoring indicated that risk assessment estimates of chemical concentrations in surface runoff from Section 13 are very conservative and significantly over-estimate the potential for runoff and concentrations of pesticide. The predicted model values have inherent uncertainty in terms of pesticide movement through subsurface pathways of preferential flow. Through previous monitoring and observation, it is evident that tile drain flow is a significant component of water movement from the orchard units to the stream systems.

Best management practices (BMPs) utilized in the 2002 spray project, BMPs included in the Orchard Water Management Plan (BLM 2002a), and protective measures (which include BMPs) and limitations in the EIS proposed action are expected to minimize the potential water quality impacts from drift, runoff, and irrigation. Monitoring water quality, documenting impacts, and adjusting practices based on this knowledge are part of the EIS design features.

This plan provides general direction for water quality monitoring whenever a pesticide or fertilizer covered under the EIS is proposed for use. The plan covers four types of monitoring: implementation monitoring, effectiveness monitoring, validation monitoring, and compliance monitoring. Implementation monitoring is intended to document the protective measures and limitation that are actually implemented. The effectiveness component documents how well these protective measures performed in avoiding introduction of chemicals to the aquatic and groundwater system. The effectiveness data would also be used to further validate that water quality modeling

conducted for the Human Health and Non-Target Species Risk Assessment was conservative for orchard units in Section 23. Compliance monitoring would be used to document domestic water quality and chemical fate in terms of irrigation using greenhouse effluent or an accidental spill.

The Human Health and Non-Target Species Risk Assessment for Pest Management at Horning Seed Orchard indicates the use of pesticides and fertilizers poses minimal threat to water quality with two possible exceptions: (1) accidental spill of pesticides directly into tributaries to both Nate and Swagger Creeks; and (2) runoff of ammonia due to potential fertilization rates.

B.1.3 Overall Objective

The overall objective of the water quality monitoring program at Horning is to document the impacts of IPM actions on water quality and to use this information to continue or modify the protective measures needed to meet the requirements for a healthy aquatic ecosystem. This documentation would include impact assessment for application of pesticides, fertilizers, spills, and irrigation using greenhouse effluent. A full assessment of protective measures used in the orchard requires monitoring both groundwater and surface water. Documentation would focus on the following monitoring questions, which were formulated based on public concerns and prior monitoring results.

B.1.4 Specific Monitoring Questions

1. Does drift of pesticides occur?

   Method: Monitor all aerial, airblast, high pressure hydraulic sprayer, and select hand-held spray applications to ensure compliance with protective measures and to document application rates, environmental conditions, and the actual occurrence of drift.

2. Does application of pesticides or fertilizers result in measurable concentrations in the streams associated with the treated fields?

   Method: Conduct effectiveness monitoring of pesticides in streams, to ensure that the implemented protective measures were effective in preventing introduction of pesticides to the aquatic system from drift, surface runoff, and subsurface runoff.

3. What are the measured chemical concentrations in tile drains (subsurface flow) from treated orchard units?

   Method: Conduct flow and chemical sampling at tile drain outlets to document chemical concentrations in the tile flow as related to application.

4. If a spill occurs, what is the potential for surface water and groundwater contamination and what are the resulting concentrations in the associated stream and groundwater area?

   Method: Depending on the type and amount of chemical, conduct surface water, groundwater, air, and soil monitoring to comply with the ODEQ Hazardous Substance Remedial Action Rules (OAR 340-122). At a minimum, sample downslope streams and the immediate groundwater table, if present. Conduct sampling of orchard domestic well if in proximity to spill.

5. Are detectible concentrations of greenhouse pesticides present in the local groundwater associated with the greenhouse effluent irrigation field?

   Method: Conduct periodic sampling of shallow groundwater wells located in the effluent field.

6. What are the cumulative effects of the most toxic pesticides included in the IPM program?

   Method: Conduct fall / winter monitoring of associated streams for analysis of select pesticides applied during the previous season.

The overall strategies to address these questions and apply these methods are provided in the following section.

B.1.5 Monitoring Strategies

B.1.5.1 Implementation Monitoring

All outdoor pesticide and fertilizer applications would be documented by the seed orchard manager or designated representative. Items to be documented include type of chemical applied, date of application, method of application, area treated, amount applied, precipitation for the three days preceding and following application, location used for mixing and loading, wind direction and speed, relative humidity, air temperature, and notes regarding whether any leakage or spills occurred. A list of all implemented protective measures for each unit treated would be provided in the Annual Horning Seed Orchard Monitoring Report with a summary included in the Salem District Annual Implementation Monitoring Summary.

Implementing protective measures and analyzing monitoring data of all types depends heavily on quality climate information. Informed decisions involving pesticide or fertilizer application rely on access to on-site weather data. Maintenance of the existing seed orchard climate station would continue providing real-time climate data including air temperature, precipitation, wind speed, wind direction, and relative humidity. These data would provide documentation of compliance and information to predict runoff patterns for effectiveness and validation monitoring.

All greenhouse pesticide and fertilizer applications would be documented by the greenhouse manager or designated representative. This would include the type of chemical applied, date of application, the amount applied, and the area in the effluent field which was irrigated. Daily water volume exiting the effluent storage tank will be recorded for comparison with weather records.

B.1.5.2 Effectiveness Monitoring

Drift

Drift Card Monitoring

All orchard units adjacent to flowing streams and planned for aerial, airblast, high-pressure hydraulic sprayer applications, and select hand-held spray applications would have spray cards placed such that drift from the application can be captured and characterized. Where the application unit is in direct proximity to a flowing stream, cards would be placed at a maximum of 50-foot intervals along the edge of the unit prior to the application. Where open canopy occurs in the stream buffer, drift cards would be placed to characterize potential intrusion of drift toward channels. Immediately after the application, the cards would be collected and reviewed to determine if any “signature” of

drift occurred, the extent of the drift, and the potential for contamination of the adjacent stream or wetland. A copy of all the cards would be kept on file at Horning, along with a record of their location and all the compliance monitoring documentation.

Surface Water Monitoring

Water samples would be taken in streams before and during the 24 hours after spray application, depending on the type of chemical, the distance from water and the application method. The time of collection would be based on the time of concentration measurements in the flowing channels associated with the treatment areas. Selection of sampling stations for surface water sampling would be based on the proximity to application areas. For aerial spray treatments, samples would be collected above and below the helicopter corridor when units in the north portion of Section 13 are treated.

All data would be used in conjunction with the spray cards to determine the effectiveness of the full "suite" of protective measures implemented to avoid drift. Samples would be analyzed at a state-certified laboratory that has detection limits of 0.02 parts per billion (ppb) for most of the potential pesticides. Samples would be collected in accordance with laboratory instructions. When sites are sampled, additional interpretive data would be collected for pH, specific conductance, turbidity, and temperature.

Runoff

Surface Runoff

Surface runoff from treated "fields" at Horning can be dispersed, transient and at times non-existent (BLM 2002b). These characteristics make it difficult to plan and implement monitoring on a "field by field" basis. The stream channels draining the pesticide and fertilizer application "fields" provide an alternative means to effectively and collectively sample for losses due to surface runoff. Data collected in the channels also provide a better indication of duration and level of exposure for aquatic species. For these reasons, effectiveness monitoring of surface runoff will focus on streamflow concentrations.

The selection of a specific pesticide or fertilizer to monitor for runoff would be planned annually and depend on the chemical characteristics of the pesticide applied (with emphasis on the more mobile chemicals with higher toxicity), the amount applied, the application method, the proximity of the treatment to the stream channel and on past monitoring results (see Responsibility discussion below).

Pesticide and fertilizer fate modeling from the Human Health and Non-Target Species Risk Assessment indicates that field runoff events within the first six months after spray application have the highest probability of carrying detectible concentrations of chemicals. One study (Rashin and Graber 1993) determined that runoff events within the first 72 hours of application were the most important in terms of increases in detectible chemical concentrations. Stream concentration sampling will be conducted during periods of precipitation that could result in field surface runoff and increases in streamflow. For Horning, this generally occurs in the late fall and winter periods, sometimes more than six months after application. These periods are most likely to carry the greatest detectible concentrations of pesticides or fertilizers in streamflow. If a runoff event occurs after spring applications, these events will be sampled.

Since most future seed production areas are in Section 23, the perennial flowing streams in this section are targeted for runoff sampling. Streams 9c and 11a in section 23 would have continuous flow recording stations that would collect samples with the intention of providing individual stormflow concentrations. These stations drain those seed production units where pesticide and fertilizer applications are more likely to be needed. The data from these stations would represent water quality conditions as a result of the effectiveness of implemented protective measures in the higher-risk seed production orchards.

Semi-permeable membrane devices (SPMDs) will be used to sample stream 9a during the spring storm and initial winter period after select pesticide applications (see datail of SPMD use in the Cumulative effects of Runoff discussion below).

All data would be used in conjunction with continuous recorded climate data to illustrate the effectiveness of design features in minimizing introduction of pesticides and fertilizers to the aquatic system. Samples would be analyzed at a state-certified laboratory that has detection limits of 0.02 ppb for most of the potential pesticides. Samples would be collected in accordance with laboratory instructions.

<u>Subsurface Runoff</u>

The orchard contains approximately 1,500 feet of "perforated drain pipe" located in orchard units identified for potential broadcast pesticide and fertilizer use. This is a concern, since water that would naturally percolate through the full soil profile (thus having significant opportunity for absorption of compounds) is allowed to move more rapidly off-site through the tile system. This is termed preferential flow, a system in which there is no proven predictive model for determining the fate of pesticides. Currently, there are no data documenting the amount of runoff moving through the tile systems or the contribution of pesticides or fertilizer from these conduits.

Previous monitoring indicates that subsurface flow could be a significant pathway for water to reach the stream system via the orchard units (BLM 2001, BLM 2002b). Since much of the drain system was installed in the 1970s and 1980s, information such as the depth and full extent of the system is unknown. As a conservative measure, management buffers are planned along tile drain "corridors". These management buffers preclude broadcast spray of pesticides and fertilizer until more is understood about the drain flow rates, linkage to surface flow, and the associated chemical concentrations. Monitoring the drain pipes would provide an indication of the effectiveness of the drain buffers and over time would provide information for planning any future application needed within the corridors.

Drain pipe flow and chemical concentration sampling are planned for three sites in the orchard. Tile site 1 is a control with no previous application of pesticide and no planned application in the future, except for herbicide spot spray. Tile site 2 is in the tile drains located in the northern portion of Section 23 draining an actively managed seed production orchard. Tile site 3 is in the tile drain located in the native seedbeds in Section 13. Continuous flow measurement would also be recorded at all three tile sites. Sampling would target pipe flow periods immediately after select applications and the first pipe flow after the summer application period. These events would be most likely to mobilize compounds in solution and sediment. Focus would be on pipe flow periods immediately after select applications and the first pipe flow after the summer application period. The selection of a specific pesticide or fertilizer to analyze would depend on chemical characteristics (with emphasis on the more mobile chemicals with higher toxicity), amount applied, application method, and proximity of the treatment to the tile area.

SPMDs would be used in Stream 2 to "accumulate" transported pesticides from the tile site 3. Tile drain concentrations would be compared to those collected in the SPMD (see description in Cumulative Effects of Runoff discussion). This monitoring would provide information to determine wetland and channel effectiveness in attenuation of pesticides in runoff from the native seed operations.

<u>Cumulative Effects of Runoff</u>

Previous monitoring for the 2001 environmental assessment did not address the potential for non-detectible chemical concentrations, which over a cumulative period could reach sublethal levels affecting beneficial uses such as fish habitat. There was concern over the transitory nature of concentrations in the storm flow period and uncertainty whether sampling is accounting for concentration which may be present. Manpower, budget, and logistics all demand that only flows with the highest potential for chemical presence are sampled. During these flow events, samples are often combined according to the rise and fall of the hydrograph, which in turn can inadvertently diminish concentrations.

In an effort to address these issues and answer the cumulative effects question, monitoring after the 2002 spray project utilized SPMDs to sequester pesticides over time. In the future, they are proposed for deployment in Streams 9a (upstream and downstream), 2, and 5a to monitor the accumulation of pesticides in reaches containing aquatic species. The SPMD is an in-stream "accumulator" which allows calculation of an average chemical concentration during the period of deployment. For this reason, the SPMDs would only be deployed during the initial winter storms and spring storms periods after pesticide application.

Stream flow gauges (USGS and BLM) would be maintained in both Streams 2 and 9a to provide flow data for deriving concentrations (chemical loading) over the period of time the SPMD is deployed. Data from the SPMD concentrations would be used to compare and validate the storm flow concentration monitored during the deployment period. Since previous monitoring has detected no esfenvalerate at 0.02 ppb for all storm flow monitoring, the SPMD would serve as an additional and potentially more accurate indicator of a "low concentration" presence of the pesticide and provide documentation of beneficial use exposure over time.

B.1.5.3 Validation Monitoring

Validation monitoring is intended to verify the water quality modeling predictions used to develop the protective measures in the EIS. Rates of surface runoff and pesticide concentrations from high risk areas within Section 13 have been monitored and shown to be significantly lower than the literature and model predictions for the soils and climate at the orchard (BLM 2002b). Future validation monitoring will focus on developing similar information for Section 23 and specifically in stream 9c. Concentrations well below those that would cause sublethal effects to fish were predicted in the Risk Assessment for Stream 9c. If future runoff sampling in stream 9c yields detectable levels of select pesticides, the concentrations would be compared to "modeled" results for the storm event sampled. These data will help validate the conservative estimates in the risk assessment.

As a partial continuation of past EA sampling, runoff samples would be captured at the edge of field P-11 (flowing to Stream 5), which is the only field observed to have had overland flow since the initiation of water quality monitoring at the orchard. This site would be sampled during the first surface runoff event following application in the upslope watershed. Once the analysis results become available, the need to sample later runoff events would be determined based on concentrations detected. Detectible concentrations would be compared with modeled results to assess the mobility of select pesticides.

B.1.5.4 Compliance Monitoring

Spill Monitoring

In the event of a chemical spill, the volume of spill, proximity to water, and chemical characteristics such as toxicity and mobility would be evaluated to determine if water sampling is desirable and necessary. If so, water samples may be collected in a sufficient number and at surface water and groundwater locations that would allow characterization of impacts and effective remediation methods. Depending on ODEQ Hazardous Substance Remedial Action Rules (OAR 340-122), monitoring could include surface water, groundwater, air, and soil. At a minimum, sampling would be conducted in the streams draining the spill area and the immediate groundwater table, if present. If in proximity to the spill, the orchard domestic well would also be sampled.

Groundwater Monitoring

The domestic well would be monitored according to the parameters outlined by the Oregon Department of Health. A pesticide would also be sampled from the well on a yearly basis during maximum well usage. The pesticide chosen would vary according to the rates, persistence, and mobility of the pesticides applied during the period since the last sampling. These samples would be collected in late summer and handled according to state-certified laboratory instructions.

On select distribution lines in the greenhouse effluent field, groundwater monitoring wells have been installed to monitor continuous groundwater elevation and periodic water quality. Water quality sampling would be conducted when risks are highest for irrigation water to potentially reach the local ground water table. Highest risk occurs when mobile pesticides are being applied in the greenhouse, effluent is being irrigated, and the local groundwater table comes in contact with the soil surface. If these "point in time" samples are found to have detectible levels of the pesticide, SPMDs would also be deployed in selected wells. These devices would allow a more quantitative determination of concentration over time. Groundwater elevation will be used to determine sampling period and irrigation timing. If a tank overflow event occurs, the distance of travel and estimated quantity would be recorded.

B.1.6 Annual Reporting

All water quality monitoring information associated with Horning's IPM program would be compiled, analyzed, and documented on a "water year" basis. This "water year" would include all monitoring performed during the October 1 to September 30 period (for example, October 1, 2003 to September 30, 2004). This information, along with any recommendation for adjustments to the protective measures and adjustments to the monitoring plan, would be contained in an <u>Annual Horning Seed Orchard Monitoring Report.</u> This report would be made available to the public and regulatory agencies on November 15 of each year and would be on file at Horning. This schedule should provide for timely inclusion of monitoring results in the <u>Annual Operating Report,</u> inclusion of the full period of runoff during the fall / winter period, and planning for the upcoming budget year.

B.1.7 Responsibility

Specific aspects of implementing this plan would be determined by the Salem District hydrologist in coordination with the seed orchard manager. At a minimum, water quality monitoring would be implemented to satisfy the terms and conditions of the NOAA Biological Opinion. The district hydrologist would be responsible for completing the "water quality monitoring component" of the Annual Horning Seed Orchard Monitoring Report for inclusion in the Annual Operation Report and for presenting results to regulatory agencies. The district hydrologist would be responsible for formalizing future water sampling plans with the seed orchard manager, selecting the sample locations and times, determining the methods for analyzing sample results, and submitting an annual budget.

The district hydrologic technician would be responsible for maintaining all surface and groundwater sampling sites, collecting all water samples, quality assurance, quality control, transferring samples to the laboratory as appropriate, coordination with the analysis lab, and providing data for analysis.

The greenhouse manager or designated representative is responsible for documentation of all pesticide and fertilizer application occurring in the greenhouse. This would include the type of chemical applied, date of application, the amount applied, and the area in the effluent field which was irrigated.

B.2 Pest Monitoring

Monitoring of pests (insects, diseases, vegetation, unwanted animals) is an integral and ongoing component of the orchard IPM program. A wide variety of monitoring tools are used to detect and report the incidence and severity of pest activity and damage to orchard resources and facilities.

Knowledge of potential pests, recognition of damage symptoms, past damage in the orchard or surrounding lands, analysis of the damage in relation to objectives, and other factors help to determine the best way to manage pests as part of an IPM program. Field observations and pest identification methods, along with specific pest and damage survey techniques, are used to detect the presence of pests and the severity of damage. Annual assessments of cone and seed insect populations and damage are used to predict potential crop damage and the need for pest control. Other insect, disease, vegetation (noxious weeds and competing vegetation), and animal pests are routinely surveyed throughout the orchard during normal orchard activities and projects and during periodic orchard tree inventories.

Pest and damage survey data are collected, summarized, and evaluated to determine if control measures are needed and the most effective methods of control. The primary focus of pest management in the orchard is the protection of cone and seed crops. A variety of methods are currently used to determine the presence of cone damaging insects at Horning.

Monitoring for the seed chalcid has taken place at Horning since 1998 using a sampling technique developed by U.S. Forest Service entomologists. Sticky traps are monitored for chalcid in the spring between the time when the first cones turn pendant until ten days after all cones are pendant. Results from this monitoring give an approximate estimate of seed chalcid populations and anticipated chalcid damage.

Monitoring for the cone gall midge has been done using two techniques: pheromone traps and ground traps. Pheromones lure the males to a sticky trap, from which information is gathered on emergence and potential damage. The procedure is still

under development by entomologists at the University of British Columbia, with their goal being to develop strong correlations between trap counts and insect damage. Ground traps have also been used to determine the timing of cone gall midge emergence from the duff and litter layer, but this method does not predict potential damage.

Cone dissection research, under the direction of Beth Wilhite, a U.S. Forest Service entomologist, is ongoing each fall following cone collection. Cones are manually dissected and seed is examined under a microscope and through x-rays to determine the degree of damage caused by each of the cone insects. The results of this process are compared with those from the spring monitoring traps, field observations, and actual seed yields.

In the future, pest monitoring plans would be modified and expanded to incorporate new research and include new pests. To help with this effort, forest health (insect and disease) specialists are contacted as necessary to assist in pest identification and assessment and to obtain IPM recommendations. For other IPM work, noxious weed specialists, botanists, wildlife biologists, fish biologists, and silviculturists may be contacted for expertise in identification of pests or control methods. Also, seed orchard staff members receive periodic training to build a knowledge base for recognition of orchard pests and damage symptoms.

B.3 Human Health Monitoring

All BLM employees involved in pesticide application programs at Horning would be required to participate in a monitoring program. Monitoring would ensure that all of the worker protection measures and limitations to protect worker health are implemented.

Documentation would include such things as names and application duties of involved individuals, chemical(s) used, dates of application, acreage and location of treatment areas, use of protective clothing and equipment, duration of exposure, and method of application.

Baseline and annual (unless no applications are made in a year) medical evaluations would be conducted on BLM employees for the use of cholinesterase-inhibiting pesticides. The Government would not conduct medical or personal monitoring of contractors involved with pesticide application.

Figure B-1: Section 13 Water Quality Sites

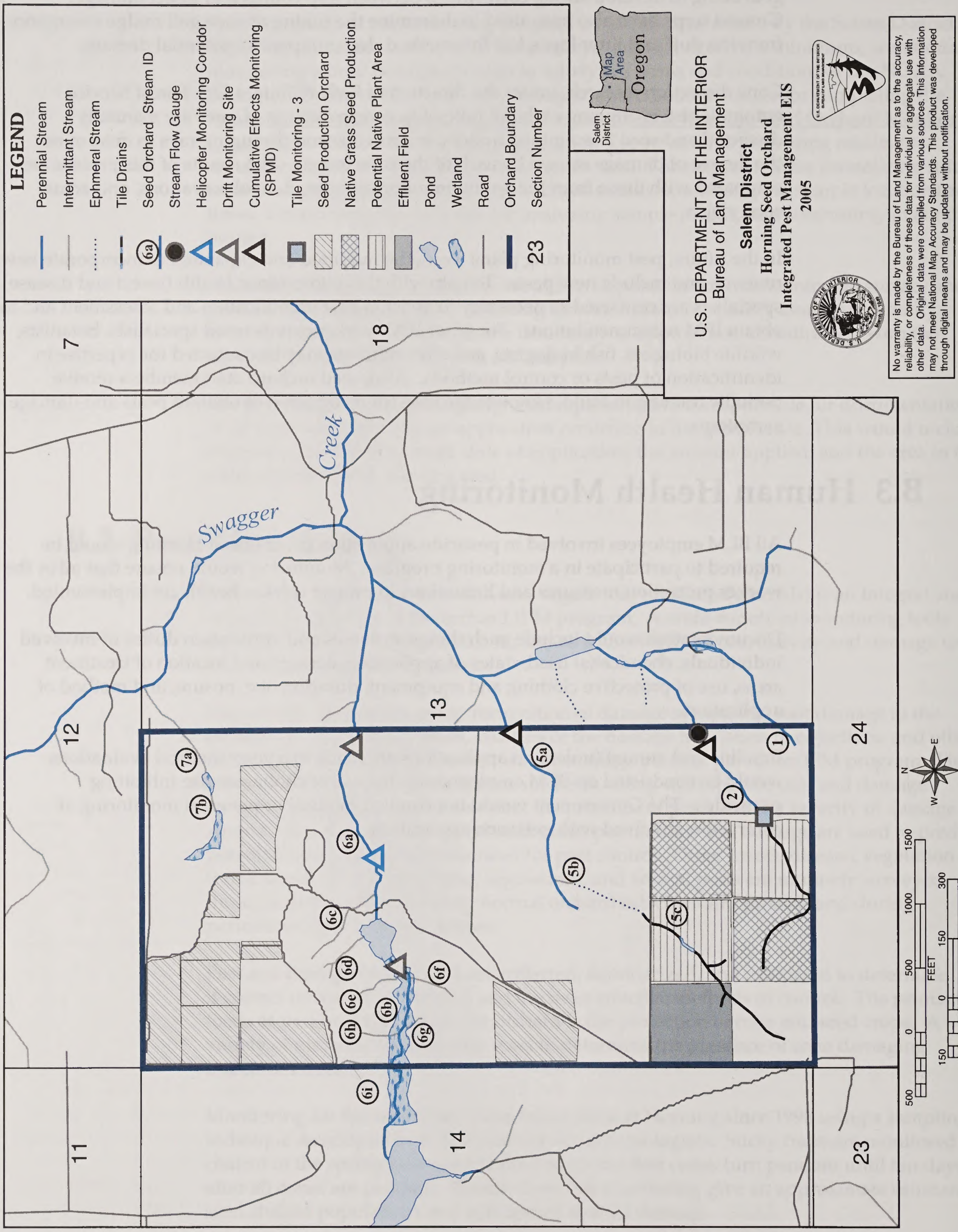
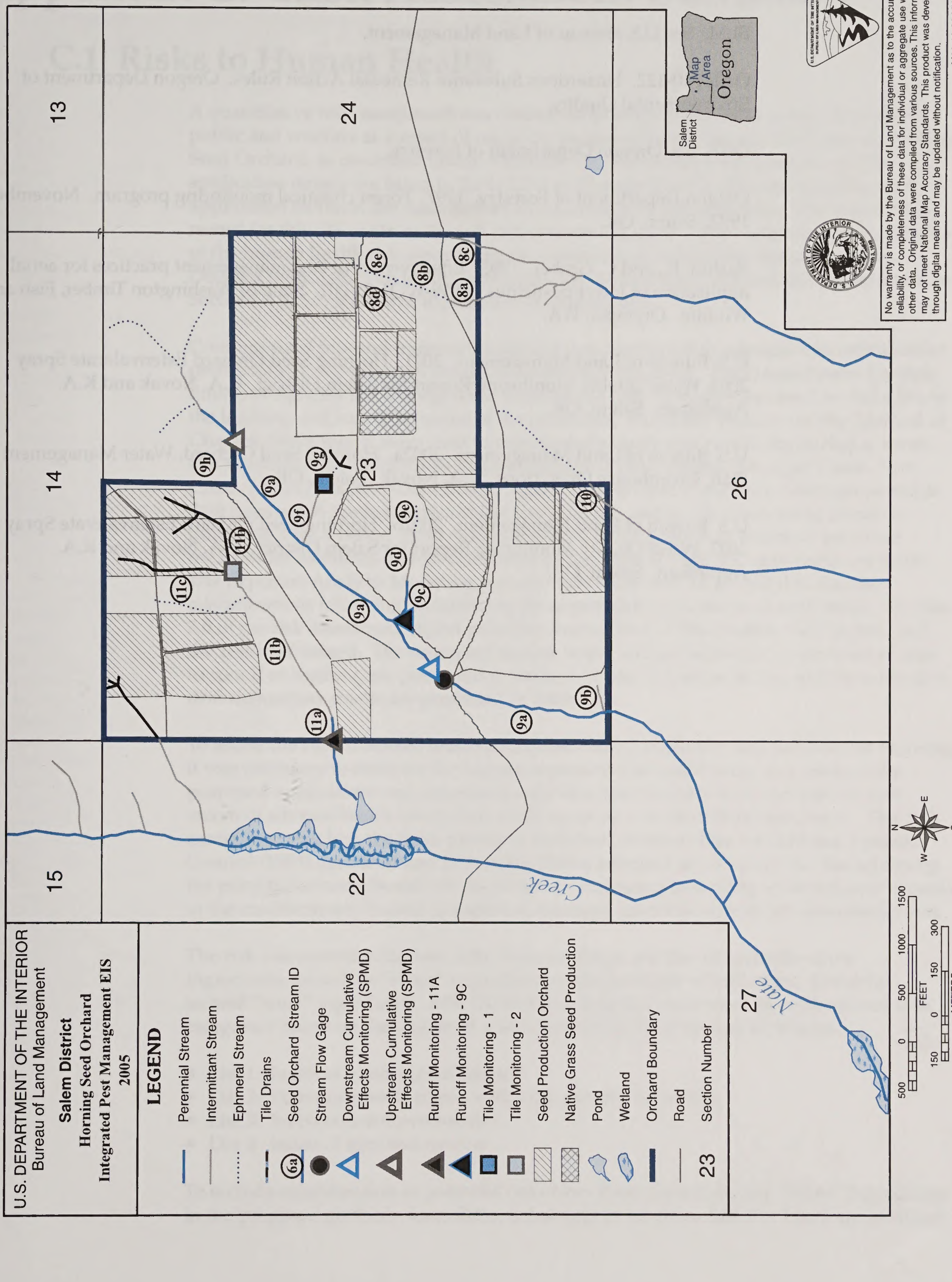


Figure B-2: Section 23 Water Quality Sites



B.4 References

BLM. See U.S. Bureau of Land Management.

OAR 340-122. Hazardous Substance Remedial Action Rules. Oregon Department of Environmental Quality.

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U.S. Bureau of Land Management. 2002a. Horning Seed Orchard, Water Management Plan, Greenhouse Operations. C.A. Novak. Salem, OR.

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Appendix C: Risk Assessment Summary

C.1 Risks to Human Health

A quantitative risk assessment was conducted to estimate the risks to members of the public and workers as a result of using the proposed pesticides and fertilizers at Horning Seed Orchard, as described under Alternative A, Maximum Seed Production. The application details are listed in Table 2.2-1 in Chapter 2 of this EIS, and the proposed application methods are described in an attachment to this appendix. The supporting record for this EIS contains the full risk assessment report. The methodology and results of the human health risk assessment are summarized in the following paragraphs. Detailed information on inputs, methodology, assumptions, and outputs can be found in Sections 4.0, 5.0, and 6.0 of the risk assessment report.

Computerized fate and transport modeling was conducted to estimate concentrations of pesticides in environmental media at the point of exposure. The Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model was used to characterize the leaching and runoff behavior of the pesticides. Published studies and the Method of Characteristics model were used to represent attenuation in runoff due to buffer zones, and to estimate concentrations in groundwater, on-site streams, Swagger Creek, Nate Creek, Milk Creek, and Clear Creek. AgDRIFT was used to estimate off-target pesticide drift from aerial applications, airblast applications, and applications using a tractor-pulled rig with a boom. Field studies reported in the published literature provided the basis for estimates of drift from other ground-based pesticide application methods. The Exposure Analysis Modeling System model was used to predict downstream concentrations following accidental spills of pesticide concentrate or tank mixes. Section 3.0 of the risk assessment report provides an overview of the models, their inputs, and the results obtained. The estimated surface water and groundwater concentrations due to runoff or leaching are presented in Tables C-1 and C-2, respectively, and the estimated drift deposition results are presented in Table C-3.

To assess the risk of human health effects from using pesticides and fertilizers at Horning, it was necessary to estimate the human exposures that could occur as a result of the proposed applications and associated activities, and to estimate the probability and extent of adverse health effects that could occur as a result of those exposures. This risk assessment employs the three principal analytical elements that the National Research Council (1983) described and EPA (1989, 2000a) affirmed as necessary for characterizing the potential adverse health effects of human exposures to existing or introduced hazards in the environment: hazard assessment, exposure assessment, and risk characterization.

The risk assessment addresses risks from fertilizers and the 19 pesticide active ingredients, as well as "other" ingredients in the pesticide formulations, formerly termed "inert" ingredients. EPA (2000b) has classified these other ingredients into four categories, based on the degree of toxicity posed by the chemical, as follows:

- List 1: Inerts of toxicological concern.
- List 2: Potentially toxic inerts, with high priority for testing
- List 3: Inerts of unknown toxicity
- List 4: Inerts of minimal concern

To include consideration of potential risks from these chemicals, any "other" ingredients in the proposed pesticide formulations that appear on either List 1 or List 2 are included

Table C-1. Estimated Surface Water Concentrations from Runoff and Erosion (mg/L).

Chemical	App Method	Section 13 Streams Typ	Section 13 Streams Max	Section 23 Streams Typ	Section 23 Streams Max	Swagger Creek Typ	Swagger Creek Max
Acephate	HPHS & HHW	-0-	-0-	-0-	-0-	-0-	-0-
Chlorpyrifos	Airblast	1.03E-006	1.58E-006	2.17E-006	3.33E-006	2.63E-007	4.11E-007
Diazinon	HPHS	1.37E-009	6.40E-005	9.96E-010	4.64E-005	3.19E-010	1.54E-005
Dimethoate	HPHS	-0-	6.91E-005	-0-	1.80E-005	-0-	1.43E-005
Cyclohexanone		-0-	3.28E-006	-0-	8.54E-007	-0-	6.80E-007
Petroleum distillate		2.84E-007	1.99E-005	7.41E-008	5.18E-006	5.57E-008	4.12E-006
Esfenvalerate	Aerial	1.75E-007	4.90E-007	4.56E-007	1.29E-006	5.06E-008	1.23E-007
Ethylbenzene		-0-	3.26E-007	-0-	8.59E-007	-0-	1.06E-007
Xylene		-0-	3.13E-008	-0-	8.23E-008	-0-	1.01E-008
Esfenvalerate	Airblast	5.81E-008	2.20E-007	1.51E-007	5.79E-007	1.68E-008	5.68E-008
Ethylbenzene		-0-	1.51E-007	-0-	3.97E-007	-0-	4.89E-008
Xylene		-0-	1.45E-008	-0-	3.81E-008	-0-	4.69E-009
Esfenvalerate	HPHS, HHW, & BP	4.60E-008	1.82E-007	1.17E-007	4.63E-007	8.36E-009	3.01E-008
Ethylbenzene		-0-	1.21E-007	-0-	3.07E-007	-0-	2.50E-008
Xylene		-0-	1.15E-008	-0-	2.94E-008	-0-	2.39E-009
Horticultural Oil	HPHS	4.75E-007	4.83E-005	-0-	-0-	8.56E-008	1.00E-005
Permethrin	Airblast & HPHS	-0-	-0-	2.02E-009	3.31E-009	-0-	-0-
Ethylbenzene		-0-	-0-	-0-	5.14E-009	-0-	-0-
Light aromatic solvent naphtha		-0-	-0-	8.84E-008	4.83E-007	-0-	-0-
Xylene		-0-	-0-	-0-	-0-	-0-	-0-
Propargite	HPHS	2.81E-007	1.00E-006	7.74E-007	2.75E-006	5.20E-008	1.66E-007
Chlorothalonil	HPHS	3.00E-008	4.05E-006	6.47E-008	8.72E-006	5.45E-009	8.39E-007
Propiconazole	Boom & BP	2.16E-008	3.58E-007	-0-	-0-	3.99E-009	5.92E-008
Dicamba	Aerial	-0-	-0-	-0-	-0-	-0-	-0-
Dicamba	Boom, HHW, & BP	-0-	-0-	-0-	-0-	-0-	-0-
Glyphosate-Roundup	Circles around trees	-0-	-0-	2.32E-007	7.06E-007	-0-	-0-
Glyphosate-Roundup	Strips along rows	3.41E-007	1.00E-006	2.64E-007	7.79E-007	6.31E-008	1.66E-007
Hexazinone	Circles around trees	-0-	-0-	-0-	6.76E-007	-0-	-0-
Hexazinone	Strips along rows	-0-	9.55E-007	-0-	6.10E-007	-0-	1.98E-007
Picloram	HHW & BP	-0-	3.14E-010	-0-	2.34E-010	-0-	6.15E-011
Hexachlorobenzene		-0-	3.14E-014	-0-	2.34E-014	-0-	6.15E-015
Triclopyr triethylamine salt	Backpack	-0-	5.14E-010	-0-	3.83E-010	-0-	1.01E-010
Triclopyr butoxyethyl ester	Backpack	2.29E-008	1.02E-006	1.71E-008	7.62E-007	3.84E-009	1.76E-007
Dazomet	Spreader	-0-	-0-	-0-	-0-	-0-	-0-
Greenhouse effluent	Irrigation						
Acephate		-0-	-0-	-0-	-0-	-0-	-0-
Chlorothalonil		-0-	-0-	-0-	-0-	-0-	-0-
Mancozeb		-0-	-0-	-0-	-0-	-0-	-0-
Thiophanate-methyl		2.30E-009	1.44E-008	-0-	-0-	3.96E-010	2.82E-009
General Fertilization	Spreader						
NO3 (as N)		2.79E-003	4.66E-003	8.24E-003	1.38E-002	8.83E-004	1.36E-003
NH4 (as N)		-0-	1.24E-002	-0-	3.66E-002	-0-	4.56E-003
PO4 (as P2O5)		7.54E-006	3.14E-003	2.23E-005	9.28E-003	2.39E-006	9.52E-004
Calcium nitrate	Spreader						
NO3 (as N)		2.45E-003	4.10E-003	4.63E-005	1.10E-003	6.76E-004	1.23E-003

*HPHS = high-pressure hydraulic sprayer; HHW = hydraulic sprayer with hand-held wand, BP = backpack sprayer

Note: 1 mg/L = 1 part per million (ppm) = 0.001 parts per billion (ppb)

Table C-1. Estimated Surface Water Concentrations from Runoff and Erosion (mg/L) (cont.).

Chemical	App Method	Nate Creek		Milk Creek		Clear Creek	
		Typ	Max	Typ	Max	Typ	Max
Acephate	HPHS & HHW	-0-	-0-	-0-	-0-	-0-	-0-
Chlorpyrifos	Airblast	1.03E-006	1.58E-006	1.66E-008	2.89E-007	1.77E-007	2.86E-007
Diazinon	HPHS	1.37E-009	6.40E-005	-0-	-0-	2.09E-010	9.95E-006
Dimethoate	HPHS	-0-	6.91E-005	-0-	5.35E-006	-0-	9.25E-006
Cyclohexanone		-0-	3.28E-006	-0-	2.54E-007	-0-	4.39E-007
Petroleum distillate		2.84E-007	1.99E-005	2.20E-008	1.54E-006	-0-	2.66E-006
Esfenvalerate	Aerial	1.75E-007	4.90E-007	1.72E-008	1.62E-007	3.40E-008	8.56E-008
Ethylbenzene		-0-	3.26E-007	-0-	1.08E-007	-0-	6.82E-008
Xylene		-0-	3.13E-008	-0-	1.04E-008	-0-	6.53E-009
Esfenvalerate	Airblast	5.81E-008	2.20E-007	1.16E-009	5.74E-008	1.13E-008	3.95E-008
Ethylbenzene		-0-	1.51E-007	-0-	3.95E-008	-0-	3.16E-008
Xylene		-0-	1.45E-008	-0-	3.79E-009	-0-	3.03E-009
Esfenvalerate	HPHS, HHW, & BP	4.60E-008	1.82E-007	-0-	-0-	5.65E-009	2.09E-008
Ethylbenzene		-0-	1.21E-007	-0-	-0-	-0-	1.61E-008
Xylene		-0-	1.15E-008	-0-	-0-	-0-	1.54E-009
Horticultural Oil	HPHS	4.75E-007	4.83E-005	-0-	-0-	5.80E-008	6.47E-006
Permethrin	Airblast & HPHS	-0-	-0-	5.62E-010	9.22E-010	-0-	-0-
Ethylbenzene		-0-	-0-	-0-	1.43E-009	-0-	-0-
Light aromatic solvent naphtha		-0-	-0-	2.47E-008	1.35E-007	-0-	-0-
Xylene		-0-	-0-	-0-	-0-	-0-	-0-
Propargite	HPHS	2.81E-007	1.00E-006	-0-	-0-	3.49E-008	1.15E-007
Chlorothalonil	HPHS	3.00E-008	4.05E-006	-0-	-0-	3.68E-009	5.42E-007
Propiconazole	Boom & BP	2.16E-008	3.58E-007	-0-	-0-	2.68E-009	4.12E-008
Dicamba	Aerial	-0-	-0-	-0-	-0-	-0-	-0-
Dicamba	Boom, HHW, & BP	-0-	-0-	-0-	-0-	-0-	-0-
Glyphosate-Roundup	Circles around trees	-0-	-0-	-0-	-0-	-0-	-0-
Glyphosate-Roundup	Strips along rows	3.41E-007	1.00E-006	-0-	-0-	4.24E-008	1.16E-007
Hexazinone	Circles around trees	-0-	-0-	-0-	-0-	-0-	-0-
Hexazinone	Strips along rows	-0-	9.55E-007	-0-	-0-	-0-	1.28E-007
Picloram	HHW & BP	-0-	3.14E-010	-0-	-0-	-0-	4.05E-011
Hexachlorobenzene		-0-	3.14E-014	-0-	-0-	-0-	4.05E-015
Triclopyr triethylamine salt	Backpack	-0-	5.14E-010	-0-	-0-	-0-	6.63E-011
Triclopyr butoxyethyl ester	Backpack	2.29E-008	1.02E-006	-0-	-0-	2.66E-009	1.21E-007
Dazomet	Spreader	-0-	-0-	-0-	-0-	-0-	-0-
Greenhouse effluent	Irrigation						
Acephate		-0-	-0-	-0-	-0-	-0-	-0-
Chlorothalonil		-0-	-0-	-0-	-0-	-0-	-0-
Mancozeb		-0-	-0-	-0-	-0-	-0-	-0-
Thiophanate-methyl		2.30E-009	1.44E-008	-0-	-0-	2.72E-010	1.86E-009
General Fertilization	Spreader						
NO3 (as N)		2.79E-003	4.66E-003	9.57E-004	1.60E-003	5.96E-004	9.42E-004
NH4 (as N)		-0-	1.24E-002	-0-	4.25E-003	-0-	2.95E-003
PO4 (as P2O5)		7.54E-006	3.14E-003	2.59E-006	1.08E-003	1.61E-006	6.54E-004
Calcium nitrate	Spreader						
NO3 (as N)		2.45E-003	4.10E-003	3.72E-004	9.90E-004	4.56E-004	8.53E-004

*HPHS = high-pressure hydraulic sprayer; HHW = hydraulic sprayer with hand-held wand, BP = backpack sprayer

Note: 1 mg/L = 1 part per million (ppm) = 0.001 parts per billion (ppb)

Table C-2. Estimated Groundwater Concentrations (mg/L).

Chemical	Method	Estimated Groundwater Concentration (mg/L) Typ	Max
Acephate	HPHS & HHW	6.13E-006	6.13E-006
Chlorpyrifos	Airblast	-0-	-0-
Diazinon	HPHS	1.64E-009	9.01E-007
Dimethoate	HPHS	1.08E-004	3.57E-004
Cyclohexanone		1.28E-005	3.72E-005
Petroleum distillate		-0-	-0-
Esfenvalerate	Aerial	-0-	-0-
Ethylbenzene		-0-	-0-
Xylene		-0-	-0-
Esfenvalerate	Airblast	-0-	-0-
Ethylbenzene		-0-	-0-
Xylene		-0-	-0-
Esfenvalerate	HPHS, HHW, & BP	-0-	-0-
Ethylbenzene		-0-	-0-
Xylene		-0-	-0-
Horticultural Oil	HPHS	-0-	-0-
Permethrin	Airblast & HPHS	-0-	-0-
Ethylbenzene		-0-	1.64E-009
Light aromatic solvent naphtha		-0-	-0-
Xylene		-0-	-0-
Propargite	HPHS	-0-	-0-
Chlorothalonil	HPHS	-0-	-0-
Propiconazole	Boom & BP	-0-	-0-
Dicamba	Aerial	-0-	-0-
Dicamba	Boom, HHW, & BP	-0-	-0-
Glyphosate-Roundup	Circles around trees	-0-	-0-
Glyphosate-Roundup	Strips along rows	-0-	-0-
Hexazinone	Circles around trees	1.70E-004	2.75E-004
Hexazinone	Strips along rows	1.06E-003	1.59E-003
Picloram	HHW & BP	2.70E-004	2.78E-003
Hexachlorobenzene		2.70E-008	2.78E-007
Triclopyr triethylamine salt	Backpack	5.47E-004	3.30E-003
Triclopyr butoxyethyl ester	Backpack	-0-	-0-
Dazomet	Spreader	-0-	-0-
Greenhouse effluent	Irrigation		
Acephate		-0-	2.30E-008
Chlorothalonil		-0-	-0-
Mancozeb		-0-	-0-
Thiophanate-methyl		-0-	-0-
General Fertilization	Spreader	-0-	-0-
NO3 (as N)		8.23E-001	8.23E-001
NH4 (as N)		-0-	-0-
PO4 (as P2O5)		1.08E-002	1.08E-002
Calcium nitrate	Spreader	-0-	-0-
NO3 (as N)		1.38E+000	1.38E+000

*HPHS = high-pressure hydraulic sprayer; HHW = hydraulic sprayer with hand-held wand, BP = backpack sprayer

Tale C-3. Estimated Drift Deposition from Aerial, Airblast Sprayer, and Boom Applications

Pesticide	Section 13 Stream Concentration (mg/L)[a]		Section 23 Stream Concentration (mg/L)[a]		Deposition at 25 Feet (lb/acre)		Deposition at Organic Farm (lb/acre)	
	Typ	Max	Typ	Max	Typ	Max	Typ	Max
Aerial (helicopter)								
Esfenvalerate	2.33E-08	1.95E-06	2.33E-08	1.95E-06	9.00E-05	4.00E-03	1.83E-08	4.70E-08
Ethylbenzene	2.77E-09	2.32E-07	2.77E-09	2.32E-07	1.7E-05	4.76E-05	2.18E-09	5.59E-09
Xylene	8.32E-09	6.96E-07	8.32E-09	6.96E-07	3.21E-05	1.43E-04	6.53E-09	1.68E-08
Airblast sprayer								
Chlorpyrifos	2.28E-05	8.18E-05	2.30E-05	8.18E-05	4.50E-03	8.99E-03	6.70E-04	1.35E-03
Esfenvalerate	1.15E-06	3.60E-06	1.15E-06	3.60E-06	2.20E-04	4.00E-03	3.00E-05	6.00E-05
Ethylbenzene	1.37E-07	4.28E-07	1.37E-07	4.28E-07	2.62E-05	4.76E-05	3.57E-06	7.14E-06
Xylene	4.11E-07	1.29E-06	4.11E-07	1.29E-06	7.85E-05	1.43E-04	1.07E-05	2.14E-05
Permethrin Ethylbenzene Light aromatic solvent naphtha Xylene	0	0	2.33E-05 1.21E-06 1.95E-05 6.20E-06	4.23E-05 2.20E-06 3.55E-05 1.15E-05	4.72E-03 2.46E-04 3.96E-03 1.26E-03	4.72E-03 2.46E-04 3.96E-03 1.26 E-03	0	0
Tractor-pulled spray rig with boom								
Propiconazole	4.46E-07	7.95E-07	0	0	2.00E-04	3.40E-04	0	0
Dicamba	9.23E-06	3.09E-05	9.38E-06	3.09E-05	1.87E-03	3.74E-03	2.90E-04	5.80 E-04
Glyphosate-circles around individual trees	0	0	1.78E-06	3.87E-06	3.60E-04	4.70E-04	0	0
Glyphosate-strips between rows of trees	9.41E-06	1.68E-05	8.56E-06	2.08E-05	1.96E-03	2.41E-03	2.80E-04	3.60E-04
Hexazinone-circles around individual trees	0	0	1.03E-06	2.63E-06	2.10E-04	3.20E-04	0	0
Hexazinone-strips between rows of trees	5.56E-06	1.48E-05	5.06E-06	1.44E-05	1.12E-03	1.73E-03	2.50E-04	2.50E-04

[a]24-hour average concentrations.

in this quantitative risk assessment, along with the active ingredient in the formulation. Accordingly, the following "other" ingredients are included in the human health (and non-target species) risk assessments:

- Cyclohexanone: present in Digon® 400 formulation of dimethoate.
- Ethylbenzene: present in the Asana® XL formulation of esfenvalerate and the Pounce® 3.2 EC formulation of permethrin.
- Light aromatic solvent naphtha: present in the Pounce® 3.2 EC formulation of permethrin.
- Petroleum distillates: present in the Digon® 400 formulation of dimethoate.
- Xylene: present in the Asana® XL formulation of esfenvalerate and the Pounce® 3.2 EC formulation of permethrin.

C.1.1 Human Health Hazard Assessment

Methodology and Data Summary

Hazard assessment requires gathering information to determine the toxic properties of each chemical and its dose-response relationship. Human hazard levels are derived primarily from the results of laboratory studies on animals. The goal of the hazard assessment is to identify acceptable doses for noncarcinogens, and identify the cancer potency of potential carcinogens.

For noncarcinogenic effects, it is generally assumed that there is a threshold level, and that doses lower than this threshold can be tolerated with little potential for adverse health effects. EPA has determined threshold doses for many chemicals; these are referred to as reference doses (RfDs). The oral RfD is an estimate of the highest possible daily oral dose of a chemical that will pose no appreciable risk of deleterious effects to a human during his or her lifetime. The uncertainty of the estimate usually spans about one order of magnitude.

EPA selects the RfD using the lowest no-observed-effect level (NOEL) from the species and study most relevant to humans. (The NOEL is the dose in a toxicity study at which there is no statistically or biological significant increase in the frequency or severity of an adverse effect in individuals in an exposed group, when compared with individuals in an appropriate control group.) In the absence of data from the most clearly relevant species, a study using the most sensitive species (the species that exhibited the lowest NOEL) is selected for use in RfD determination. This NOEL is divided by an uncertainty factor (usually 100) consisting of a factor of 10 to allow for the variation of response within the human population and a factor of 10 to allow for extrapolation to humans. Additional uncertainty factors may be applied to account for extrapolation from a shorter term study, overall inadequacy of data, or failure to determine a no-effect level. RfDs are expressed in units of mg/kg/day.

In many cases, exposures to the chemicals proposed for use at Horning will not occur every day for a person's lifetime, but over a shorter duration. EPA's Risk Assessment Guidance for Superfund (EPA 1989) discusses the use of subchronic RfDs when exposures may range from two weeks to seven years in duration, instead of an individual's entire lifetime. These subchronic RfDs are *not* used in the assessment of risks from seed orchard chemicals, for the following reasons:

- The seed orchard pesticide and fertilizer use programs are anticipated to be in effect for more than seven years, exceeding the upper time limit for exposure in EPA's

discussion of appropriate use of subchronic RfDs. It is safe to assume that length of employment and length of residence may make the exposure scenarios applicable to an individual worker or nearby resident for longer than a seven-year period.

- EPA (2000c) stated that subchronic RfDs should not be used to evaluate risks to children, as they may not be sufficiently protective. Children are a subset of the general public whose risks are assessed in the analysis.

Additionally, the use of chronic RfDs provides a more conservative estimate of the dose-response relationship in all cases, decreasing the likelihood of underestimating any potential risks to any worker or member of the public.

Data on carcinogenic potential were reviewed for each chemical. Acephate, permethrin, propargite, and thiophanate-methyl are considered possible human carcinogens; and chlorothalonil, mancozeb, and hexachlorobenzene (a contaminant in picloram) are considered to be probable human carcinogens. For these compounds, cancer slope factors that have been calculated by EPA or other appropriate sources are used in this risk assessment. The cancer slope factor of a chemical represents the probability that a 1-mg/kg/day chronic dose will result in formation of a tumor, and is expressed as a probability, in units of "per mg/kg/day" or $(mg/kg/day)^{-1}$.

The RfDs and cancer slope factors used in this risk assessment are summarized in Table 4.6-1 in Chapter 4 of this EIS.

Data Availability and Quality

A consistent level of information on all data points researched was not available for all of the chemicals evaluated in this risk assessment. For the endpoints evaluated in this quantitative risk assessment, there are no data gaps in the information available for acephate, chlorothalonil, chlorpyrifos, diazinon, dimethoate, esfenvalerate, glyphosate, horticultural oil, hydrogen dioxide, mancozeb, permethrin, picloram, propargite, propiconazole, and thiophanate-methyl. However, the following data gaps were identified and addressed as described:

- No dermal absorption data were available for dazomet, so a value of 10% was assumed. Inhalation exposure to dazomet's hydrolysis products is expected to be the route with the highest potential for exposure to humans from this pesticide, so this assumption is not likely to significantly affect the conclusions of the risk assessment.

- No studies of dermal absorption were available for dicamba. USDA (1984) recommended a value of 10% as a conservative assumption. This value is used in the risk assessment.

- Hexazinone's carcinogenic potential is unknown, with equivocal results from one study in mice and negative results from a study in rats. Cancer risks are not quantified for this pesticide.

- Conclusive information was not available on triclopyr's potential for carcinogenicity. Therefore, no judgment was made as to whether it is potentially carcinogenic, and no quantitative cancer risk analysis was conducted.

- No dermal absorption factor was identified for cyclohexanone. A value of 10% was selected for use in the risk assessment. Carcinogenicity findings for cyclohexanone were inconclusive. No quantitative analysis of the compound's cancer risk is conducted.

- Inhalation studies of ethylbenzene in rats and mice resulted in some tumors in the high-exposure groups, although EPA lists it as not classifiable as to human carcinogenicity. No cancer risk assessment is conducted for this chemical.

- Although naphthalene (an example of the "other" ingredient light aromatic solvent naphtha) is considered a possible human carcinogen, the available data do not allow calculation of a cancer slope factor; therefore, no quantitative estimate of cancer risk from light aromatic solvent naphtha compounds is made. No dermal absorption data were available, so a default value of 10% was selected for use in the risk assessment.

- For xylene, one negative and one equivocal carcinogenicity study were reported, and dermal studies have indicated a potential for xylene to be a promoter or co-carcinogen for skin cancer. Due to the lack of conclusive information, no judgment was made in this risk assessment as to whether xylene is potentially carcinogenic, and no quantitative cancer risk analysis was conducted for it.

- No dermal absorption data were available for the fertilizers. A value of 1% was used in the risk assessment.

C.1.2 Human Health Exposure Assessment

Exposure assessment involves estimating doses to persons potentially exposed to the pesticides or fertilizers. In the exposure assessment, dose estimates were made for typical, maximum, and accidental exposures. These exposures are defined as follows:

- *Typical:* For this risk assessment, the word "typical" refers to a level of exposure within a scenario, and does not indicate whether the scenario itself is likely to occur. Typical exposure reflects the average dose an individual may receive if all exposure conditions are met. Typical exposure assumptions include the application rate usually used at the seed orchard, usual number of applications per year, the average of the ten highest values for chemical concentrations predicted to be present in runoff over a 10-year period of annual typical applications, and other similar assumptions.

- *Maximum:* Maximum exposure defines the upper bound of credible doses that an individual may receive if all exposure conditions are met. Maximum exposure assumptions include the maximum application rate according to the label, maximum number of applications per year, the highest chemical concentration predicted to be present in runoff over a 10-year period of annual maximum applications, and other similar assumptions.

- *Accidental:* The possibility of error exists with all human activities. Therefore, it is possible that during seed orchard operations, accidents could expose individuals to unusually high levels of pesticides or fertilizers. To examine these potential health effects, several accident scenarios were evaluated for health effects to members of the public and workers.

It is important to note that these exposure scenarios estimate risks from clearly defined types of exposure. If all the assumptions in an exposure scenario are not met, the dose will differ from that estimated here, or may not occur at all.

For members of the public, the exposure scenarios analyzed in this risk assessment consist of the following:

- Ingestion of groundwater.

- Ingestion of water from Swagger Creek east of Section 13 or Nate Creek west of Section 23. (These creeks are not known sources of drinking water; therefore, drinking water from their tributaries is even less likely and this risk was not quantified).

- Ingestion of fish from Swagger Creek east of Section 13 or Nate Creek west of Section 23.

- Ingestion of grouse or quail hunted on or near grounds.

- Ingestion of mushrooms with pesticide residues.

- Dermal exposure to insecticide/fungicide drift residues on vegetation, or herbicide treatment residues on vegetation, during recreational hiking/hunting/mushroom gathering on orchard grounds.

- Dermal exposure to residues on dogs following recreational use of site.

The categories of workers evaluated in this risk assessment for occupational exposure to pesticides are as follows:

- Helicopter pilot.
- Helicopter mixer/loader.
- High-pressure hydraulic sprayer mixer/loader/applicator.
- Hydraulic sprayer with hand-held wand mixer/loader/applicator.
- Tractor-pulled spray rig with boom mixer/loader/applicator.
- Backpack sprayer mixer/loader/applicator.
- Granular spreader loader/applicator.
- Hand pollinator.
- Hand sprayer mixer/loader/applicator in greenhouse.
- Chemigation mixer/loader in greenhouse.
- Weighing and monitoring personnel in greenhouse.

Several accidental exposure scenarios were also evaluated:

- Ingestion of groundwater after a spill of concentrate.
- Ingestion of fish and water containing runoff from a spill of concentrate.
- Ingestion of fish and water downstream of a spill of tank mix directly into a stream.
- Spill of pesticide concentrate onto worker's skin.
- Spill of pesticide mixture onto worker's skin.
- Spray of worker with tank mix of pesticide.

C.1.3 Human Health Risk Characterization

Methodology

Risk characterization requires comparing the hazard information with the dose estimates to predict the potential for health effects to individuals under the conditions of exposure. The risk characterization also identifies uncertainties (such as data gaps where scientific studies are unavailable) that may affect the magnitude of the estimated risks.

In this risk assessment, the potential noncarcinogenic risks were evaluated by comparing the representative doses (estimated in the exposure assessment) with the RfDs (identified in the hazard assessment). All the RfDs used in this risk analysis take into account multiple exposures over several years and represent acceptable dose levels. The comparison of dose to RfD consists of a simple ratio, called the hazard index:

$$\textit{Hazard Index} = \textit{Estimated Dose (mg/kg/day)} \div \textit{RfD (mg/kg/day)}$$

If the estimated dose does not exceed the RfD, the hazard index will be one or less, indicating a negligible risk of noncarcinogenic human health effects.

A dose estimate that exceeds the RfD, although not necessarily leading to the conclusion that there will be toxic effects, clearly indicates a potential risk for adverse health effects. Risk is presumed to exist if the hazard index is greater than one. However, comparing one-time or once-a-year doses (such as those experienced by the public or in an accident) to RfDs derived from long-term studies with daily dosing tends to exaggerate the risk from those infrequent events.

For workers and the public, hazard indices were computed for each chemical, application, and scenario for typical, maximum, and accident situations. For pesticide formulations containing ingredients on EPA's List 1 or 2 of "other" ingredients, the hazard indices for each component of the formulation are added together, to indicate the total risk to the exposed individual from that pesticide.

If the hazard index exceeds one, the risk may require mitigation, depending on the circumstances of exposure. For workers, this may mean reducing the quantity of pesticide to which the worker is exposed or increasing the level of protective clothing. For members of the public, it may mean decreasing the application rate or using measures to reduce the potential for runoff to reach streams. In some cases, the simple mitigation procedures will not reduce exposures (and thereby decrease the hazard index) to an acceptable level. In these cases, the seed orchard manager may consider use of a different pesticide or use a non-pesticide method to meet management goals.

To estimate cancer risk, the dose is averaged over a lifetime (75 years), and multiplied by the chemical's cancer slope factor. The resulting cancer probability is compared to a benchmark value of one in one million, a value commonly accepted in the scientific community as representing a cancer risk that would result in a negligible addition to the background cancer risk of approximately one in four in the U.S.

Risk Summary

Hazard indices and cancer risks for each chemical and scenario are presented in tables in Section 6.0 of the risk assessment report. The chemicals and scenarios for which risks were identified are summarized in the following paragraphs and in Table 4.6-2 in Chapter 4 of this EIS.

Members of the Public

For members of the public, hazard indices were less than one for all typical and maximum exposure scenarios, and cancer risks were all less than 1×10^{-6} (one in one million), with non-zero cancer risks ranging up to 1.22×10^{-9} (1.22 in one billion).

Workers

For typical scenarios, worker hazard indices are less than one, with the following exceptions:

- A high-pressure hydraulic sprayer mixer/loader/applicator applying diazinon or dimethoate, and

- A backpack sprayer applying propiconazole, dicamba, or hexazinone.

In the maximum scenarios, the hazard indices exceed one for the following workers:

- A high-pressure hydraulic sprayer mixer/loader/applicator applying diazinon or dimethoate;
- A backpack sprayer applying dicamba or hexazinone; and
- A hand pollinator encountering residues of diazinon.

The estimated cancer risk to greenhouse weighing/monitoring personnel encountering residues of mancozeb is 5.15 in one million, exceeding the standard point of departure of one in one million. All other cancer risks to workers were less than one in one million.

Risk Management Approaches

If applications of these pesticides were prescribed, risks to mixer/loader/applicators could be mitigated by decreasing the application rate, using water soluble bags (if available), spreading the work over a longer time period, increasing the use of personal protective equipment, and dividing the work between two or more workers. Risks to hand pollinators could be mitigated by increasing the time period between applications and pollination activities to allow additional degradation, decreasing the application rate, increasing the use of personal protective equipment, and dividing the work between two or more workers.

Accidents

For a spill of a container of pesticide concentrate at the mixing area, no risks to the public from drinking groundwater contaminated by leached chemical were predicted. If precipitation caused runoff of spill residues to surface water from the spill site, risks were predicted from diazinon, dimethoate, permethrin, and chlorothalonil to adults and children consuming fish or surface water from Swagger Creek. All estimated cancer risks were less than one in one million.

For a spill of an application tinkled of mixed pesticide into the onsite stream east of Horning Reservoir, risks to the public from drinking water and eating fish from Swagger Creek are predicted for acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, propargite, chlorothalonil, propiconazole, dicamba, hexazinone, picloram, and dazomet. Cancer risks from permethrin and propargite exceed one in one million.

For a spill of an application tinkled of mixed pesticide into the onsite stream east of orchard unit B14, risks to the public from drinking water and eating fish from Swagger Creek are predicted for acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, propargite, chlorothalonil, propiconazole, dicamba, hexazinone, picloram, and dazomet. Cancer risks from permethrin and propargite exceed one in one million.

For a spill of an application tinkled of mixed pesticide into the onsite stream west of orchard unit P67, risks to the public from drinking water and eating fish from Nate Creek are predicted for acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, propargite, chlorothalonil, propiconazole, dicamba, hexazinone, and dazomet. Cancer risks from permethrin and propargite exceed one in one million.

In the scenario in which a worker spills liquid pesticide concentrate on the skin, hazard indices exceed one (ranging up to 10,100 for dimethoate) for all liquid concentrates except horticultural oil, glyphosate, picloram, and triclopyr. Estimated cancer risks were all less than one in one million.

In the scenario in which a worker spills tank-mixed diluted pesticide on the skin, hazard indices are greater than one for chlorpyrifos, diazinon, dimethoate, and dicamba. All estimated cancer risks are less than one in one million.

Hazard indices for the accident scenario in which a worker was directly sprayed exceed one for chlorpyrifos, diazinon, and dimethoate. Estimated cancer risks are all less than one in one million.

Cumulative Human Health Risks

No data indicating synergistic toxicity exists among the proposed chemicals were identified. Therefore, cumulative human health risks were estimated assuming additive toxicity.

For members of the public, risks were aggregated from all routes of exposure for each chemical, as estimated for the typical scenarios. These chemical-specific aggregated risks were then added together to provide an upper bound estimate of the cumulative risk for adults and children. Actual cumulative risk values are likely to be far less than the results estimated in this assessment, since (1) it is highly unlikely that one individual would be exposed to every chemical in all of the scenarios evaluated in the risk assessment; (2) several pesticides are proposed for use as alternatives for certain groups of target pests or weeds, and if one was selected for use in a given season, the alternatives would not also be used; (3) where multiple application methods are possible for a proposed pesticide treatment scenario, the method with the highest associated risk was included in the cumulative assessment; and (4) the temporal spacing of the potential chemical applications would correspond to a timeline in which some exposure routes were no longer active due to dissipation and degradation, prior to application of other chemicals. The upper bound cumulative risk estimates are as follows:

- Cumulative hazard indices are 0.342 and 0.809 for adult and child members of the public, respectively. These values do not exceed the reference value of one, at which noncarcinogenic hazard indices are concluded to represent a risk.

- Cumulative cancer risks are 1.07 x 10-9 (1.07 in one billion) and 2.64 x 10-9 (2.64 in one billion) for adult and child members of the public, respectively. Neither value exceeds the cancer risk criterion of one in one million.

For workers, the highest cumulative exposure could occur if one employee was involved in all pesticide applications, with the exception of aerial applications, which are always conducted by a contractor. In this case, the cumulative hazard index for workers is 39.5, and the cumulative cancer risk is 7.15 in one million. It is important to note that this cumulative risk scenario includes the unlikely case in which all pesticides that target every pest problem are called for during the season. The highest contributor to the cumulative hazard index is dimethoate (24.7) for an individual applying the chemical using a high-pressure hydraulic sprayer and conducting hand pollinating activities. The estimated cumulative cancer risk to workers is 7.15×10^{-6}. The main contributor to this risk is mancozeb, which is associated with a 6.08×10^{-6} cancer risk for an individual conducting hand sprayer applications and weighing/monitoring activities in the greenhouse.

Uncertainties

The risks summarized in this assessment are not probabilistic estimates of risk, but are conditional estimates. That is, these risks are likely only if all exposure scenario assumptions that were described are met. In addition, the methodology applied to

estimating risks is not definitive, since uncertainty in the final risk estimates is introduced in almost every step of the assessment. Some of the primary areas of uncertainty are as follows:

- The accuracy of the RfDs in approximating doses to humans that pose negligible risk of health effects, without either under- or overestimating these doses: the RfDs are derived from tests in laboratory animals. Extrapolating the results of animal tests to human health hazards has an inherent level of uncertainty associated with it.

- The use of the conservative approach, recommended by EPA, that chronic toxicity data be used in estimating risks from occasional (or, at most, subchronic) exposures to the chemicals proposed for use at the seed orchard.

- The cancer slope factors, in providing a good approximation of the chemical's carcinogenic potency in humans: updated guidelines for estimating cancer risks are in progress that may provide a different approach to estimating cancer risks for some of the chemicals evaluated in this report (see discussion in Section 6.2.2 of the risk assessment report). However, reassessment of the carcinogenic mechanism and application of an appropriate strategy for cancer risk assessment for any one chemical may be years away. This analysis uses the cancer risk approach currently used by EPA for estimating the cancer potency of each chemical.

- The equations and studies on which the dose estimations are based: Many monitoring studies have been conducted since the 1970s that measure exposures to pesticides in a range of situations. This risk assessment relies on those that (1) are most relevant to the types of applications at the seed orchard, (2) incorporated sound methodology to provide a degree of confidence in the reported results, and (3) monitored, correlated, and reported a sufficient number of parameters to allow extrapolation to other situations.

All together, it is likely that the uncertainty in the risk estimates predicted in this assessment spans at least an order of magnitude. For example, for a hazard index estimated to be 0.0035, the true value is likely to be within the range of 0.035 to 0.00035, as a result of the uncertainties described here.

C.2 Risks to Non-Target Species

A quantitative non-target species risk assessment was conducted to evaluate the potential effects of the proposed chemical pesticides on terrestrial and aquatic wildlife species. The methodology and results are summarized in the following paragraphs; detailed information on inputs, methodology, assumptions, and outputs can be found in Sections 7.0, 8.0, and 9.0 of the risk assessment report.

The results of computerized fate and transport modeling were used to estimate concentrations of chemicals at points of exposure for non-target species, just as described in the summary of the human health risk assessment. Details of the methods and models can be found in Section 3.0 of the risk assessment report. Estimated surface water concentrations from runoff and drift are presented in Tables C-1 and C-3.

The non-target species risk assessment follows the steps of problem formulation, analysis, and risk characterization, as described in EPA's Guidelines for Ecological Risk Assessment (EPA 1998). This risk assessment also identifies uncertainties that are associated with the conclusions of the risk characterization. Risks to non-target species were evaluated for the fertilizers, pesticides, and List 1 or 2 "other" ingredients in the pesticide formulations.

C.2.1 Problem Formulation

In problem formulation, the purpose of the assessment is provided, the problem is defined, and a plan for analyzing and characterizing risk is determined. The potential stressors (in this case, pesticides and fertilizers), the ecological effects expected or observed, the receptors, and ecosystem(s) potentially affected are identified and characterized. Using this information, the three products of problem formulation are developed: (1) assessment endpoints that adequately reflect management goals and the ecosystem they represent, (2) conceptual models that describe key relationships between a stressor and assessment endpoint, and (3) an analysis plan that includes the design of the assessment, data needs, measures that will be use to evaluate risk hypotheses, and methods for conducting the analysis phase of the assessment.

The ecological effects that may be associated with the chemical pesticides and fertilizers are those associated with direct toxicity to non-target species that encounter the chemical. Permanent or persistent exposures through environmental pathways are not expected, since the half-lives of these chemicals are on the order of one month or less. Control of certain pests and vegetation in and of itself is not expected to affect the area's wildlife, since the seed orchard is a managed area, and has been managed for tree species preservation and seed production for 33 years.

The receptors in this non-target species risk assessment were selected to represent the range of species present at or near Horning, along with specific evaluation of special status species that may inhabit or visit the site. These receptors include mammals, birds, reptiles, amphibians, fish, and aquatic vertebrates for which quantitative risk estimates can be made.

Assessment endpoints are selected based on three criteria: ecological relevance, susceptibility to stressors, and relevance to management goals (EPA 1998). For special status species, the assessment endpoint selected is individual survival, growth, and reproduction. For general species present at the seed orchard, the assessment endpoint selected is the survival of populations.

A conceptual model was developed to illustrate the relationships between stressors, exposure routes, and receptors. The conceptual model is presented in Figure 4.7-1 in Chapter 4 of this EIS.

Based on the conceptual model, an analysis plan was developed with the following components:

- Selection of typical and maximum exposure scenarios to evaluate risks to terrestrial and aquatic wildlife species;
- Identification of representative terrestrial and aquatic species and their characteristics, illustrating the various types of exposure that wildlife species may have to chemicals used at the seed orchard;
- Estimation of environmental exposures in terms of dose (mg/kg) for terrestrial species or concentration (mg/L) for aquatic species;
- Research and summary of the toxic properties of each pesticide, "other" ingredient, and fertilizer to wildlife species, to identify endpoints, including median lethal doses (LD50s), median lethal concentrations (LC50s), and maximum acceptable toxicant concentrations (MATCs); and
- Comparison of the doses and concentrations identified in the exposure characterization to the toxic properties identified in the effects characterization, using

the guidelines specified by EPA's Office of Pesticide Programs for interpreting risk estimates to general wildlife and to special status species.

C.2.2 Analysis

Analysis is a process that examines the two primary components of risk–exposure and effects–and the relationships between each other and ecosystem characteristics. The assessment endpoints and conceptual models developed during problem formulation provide the focus and structure for the analysis. Exposure characterization describes potential or actual contact or co-occurrence of stressors with receptors, to produce a summary exposure profile that identifies the receptor, describes the exposure pathway, and describes the intensity and extent of contact or co-occurrence. Ecological effects characterization consists of evaluating ecological effects (e.g., ecotoxicity) data on the stressor of interest, as related to the assessment endpoints and the conceptual models, and preparing a stressor-response profile.

The terrestrial species exposure scenarios postulate that a variety of terrestrial wildlife species use the Horning Seed Orchard at various times. The scenarios further postulate that these terrestrial species may be exposed to any applied pesticides or fertilizers through ingestion of contaminated food and water and, in the maximum scenario, direct dermal spray as a result of being in an area while a treatment is occurring.

The list of representative species is as follows:

Mammals
- Cow (domestic)
- Sheep (domestic)
- Coyote (carnivore)
- Jack rabbit (small herbivore)
- Long-eared myotis (insectivore)

Birds
- Black-capped chickadee (conifer seed-eater)
- California quail (game bird)
- Mallard duck (water fowl)
- Red-tailed hawk (raptor)
- Song sparrow (seed-eater)

Reptiles/Amphibians
- Pacific tree frog

These particular wildlife species were selected because they represent the majority of the species present, or the seed orchard has suitable habitat and is within their range (e.g., selection of black-capped chickadee as conifer seed-eater), and because they represent several types of coverage: a range of phylogenetic classes, body sizes, foraging habitat, and diets for which parameters are generally available. In addition, several special status terrestrial species were evaluated for potential risk:

- western pond turtle
- common nighthawk
- Oregon vesper sparrow
- western meadowlark
- streaked horned lark

For each species, characteristics were identified that were used in estimating doses of pesticides, other ingredients, and fertilizers. These characteristics include body weight,

surface area, water intake, dietary intake, composition of diet, and home range/foraging area.

Risks were also estimated for aquatic species for which ecotoxicity data are available: rainbow trout as a representative coldwater fish species, the water flea *Daphnia magna* as a representative aquatic invertebrate, and tadpoles of the Pacific tree frog as a representative amphibian aquatic stage. Risks were also evaluated for steelhead trout, a Federally listed threatened species and state-listed critical species that is present in Clear Creek and Milk Creek near Horning. At the time of the risk assessment, cutthroat trout were proposed for Federal listing as threatened, so they were evaluated as if they were a special status species. However, subsequent to the risk assessment's completion, it was determined that these cutthroat trout would not be listed.

Stressor-response profiles were prepared for each pesticide, "other" ingredient, and fertilizer proposed for use at Horning. These profiles addressed ecotoxicity to both terrestrial and aquatic species, with the goal of identifying endpoints relevant to the types of exposure and methodology used in the assessment. The focus of this research was to identify LD_{50}s, LC_{50}s, and MATCs. The stressor-response profiles for all chemicals are presented in Section 8.3 of the risk assessment report.

C.2.3 Risk Characterization

Risk characterization uses the results of the analysis phase to develop an estimate of the risks to ecological entities, describes the significance and likelihood of any predicted adverse effects, and identifies uncertainties, assumptions, and qualifiers in the risk assessment.

By comparing the exposure profile data (estimated dose or water concentration) to the stressor-response profile data (LD_{50}s, LC_{50}s, MATCs), an estimate of the possibility of adverse effects can be made. The levels of concern are determined following the quotient methodology used by EPA's Office of Pesticide Programs. The quotient is the ratio of the exposure level to the hazard level. For acute exposures, the levels of concern at which a quotient is concluded to reflect risk to non-target species are as follows:

- Terrestrial species (general): 0.5, where dose equals one-half the LD_{50}.
- Terrestrial species (special status): 0.1, where dose equals one-tenth the LD_{50}.
- Aquatic species (general): 0.5, where water concentration equals one-half the LC_{50}.
- Aquatic species (special status): 0.05, where water concentration equals one-twentieth the LC_{50}.

Due to the high level of concern for protecting threatened salmonids in the watershed, the predicted water concentrations are also compared to the MATC for a chemical, if available.

Quotients for each chemical and scenario are presented in tables in Section 9.0 of the risk assessment report. The chemicals and scenarios for which risks were identified are summarized in the following paragraphs and in Table 4.7-2 in Chapter 4 of this EIS.

Risks to Terrestrial Wildlife

<u>Risks to General Terrestrial Species</u>

Risks are predicted from chlorpyrifos for the black-capped chickadee in the typical and maximum scenarios, and for the song sparrow in the maximum scenario.

Risks are predicted from diazinon for the black-capped chickadee and California quail in the typical and maximum scenarios, and for the mallard duck, red-tailed hawk, and song sparrow in the maximum scenario.

Dimethoate was estimated to present risks to the black-capped chickadee, California quail, song sparrow, and Pacific tree frog in the typical scenario, and to all general terrestrial species except the coyote and jackrabbit in the maximum scenario.

In most cases, little or no adverse impact to terrestrial wildlife populations is expected from the pesticides and fertilizers proposed for use at Horning under typical conditions of use, with the possible exception of impacts to bird and amphibian species from applications of three of the insecticides (chlorpyrifos, diazinon, and dimethoate). Most of the estimated doses are extremely low, with risk quotients several orders of magnitude below the levels of concern. A margin for error is provided by the methodology applied, which uses reasonable assumptions that tend toward overstating potential exposures to wildlife, in the absence of site-specific data on potential exposure patterns. In addition, all of the chemicals have relatively short half-lives and are not expected to remain in the environment for significant periods of time.

Although some terrestrial insects onsite may be affected by the insecticide applications, and may constitute a portion of the dose to insectivorous species, populations of beneficial insects as a whole are not expected to suffer adverse impacts because the proposed seed orchard applications are localized. Although honeybees and other pollinators are generally susceptible to insecticides, the standard operating procedures at Horning include practices to mitigate potential exposures.

It appears that insecticide applications may have adverse impacts on local earthworm populations (see discussion in Section 9.2.1 of the risk assessment report). However, any possible impacts are expected to be reversible, given that these chemicals are not persistent in the soil and that limited areas would be treated only on an as-needed basis in any growing season, allowing for re-population from adjacent untreated areas.

Risks to Special Status Terrestrial Species

Risks are predicted from chlorpyrifos, diazinon, and dimethoate for all special status terrestrial species in both the typical and maximum scenarios.

Calcium nitrate application was estimated to pose a risk to the western pond turtle in both typical and maximum scenarios, and to the common nighthawk and Oregon vesper sparrow in the maximum scenario.

Risks to Terrestrial Plants

The proposed herbicides will be variously toxic to any plants with which they come into contact. No special status plant species have been identified on site at the seed orchard. Broadcast applications of herbicides are only proposed for intensively managed or disturbed areas such as along roads and fences, within orchard units, or around facilities, while spot applications will be used to control weed species in less disturbed areas. Only spot hand applications would be conducted within the riparian buffer areas. Insecticides, fungicides, and fertilizers are only proposed for use in cultivated areas (seed orchard blocks and native grass beds), so no direct contact with plant species in other areas is expected.

Risks to Aquatic Species

Risks to General Aquatic Species

No risks to general coldwater fish species, aquatic invertebrates, or aquatic stages of amphibians were predicted in onsite streams in the typical or maximum scenarios.

Drift from permethrin airblast applications was predicted to exceed the MATC for aquatic invertebrates in onsite streams. However, it is important to note that the permethrin concentration is expressed as a 24-hour average, while the MATC was based on a 21-day study period; therefore, this is a very conservative indication of any potential risk.

Risks to Special Status Aquatic Species

In the risk assessment, ammonia in runoff from general orchard fertilization was predicted to pose a risk to cutthroat trout in Section 13 onsite streams in the maximum scenario only. However, after the risk assessment was completed, it was determined that cutthroat trout would not be listed as a threatened species; therefore, the risk threshold for general species (Q = 0.5) would apply to cutthroat trout as well. No risks are predicted from ammonia based on current information.

Risks from Accidental Spills

Risks are predicted for all terrestrial species except the cow, sheep, and coyote in the scenario in which an animal ingests an acephate implant capsule.

General terrestrial species were predicted to be at risk from a concentrate spill of diazinon, esfenvalerate, or dazomet at the mixing area.

Most categories of aquatic species (fish, invertebrates, amphibians, both general and special status) are at risk from spills of tank mixtures of chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, propargite, chlorothalonil, dicamba, glyphosate (Roundup), hexazinone, horticultural oil, picloram, and triclopyr butoxyethyl ester into the irrigation pond, or into onsite tributaries to Swagger Creek and Nate Creek. No risks were predicted in any spill scenarios from acephate, propiconazole, glyphosate (Rodeo), or triclopyr triethylamine salt. Risks to steelhead in Clear Creek or Milk Creek would be less than those presented here (which assumed the species was present in Swagger Creek and Nate Creek), due to greater dilution.

Risks to Aquatic Plants

Aquatic plants may be present in streams and ponds that receive runoff from treated areas. A literature review was conducted to identify the levels at which any of the proposed chemicals may pose a hazard to aquatic plants (see Section 9.2.4 in the risk assessment report). For many chemicals, tests in algae were the only available data, and are expected to provide a sensitive endpoint for hazards to aquatic plants. For each chemical, the estimated water concentrations were compared to the levels of concern. None of the predicted concentrations in onsite streams, Swagger Creek, or Nate Creek exceed the effects criteria equivalent to 50% of the values reported in the literature reviewed. Therefore, no adverse effects to aquatic plants are expected under typical or maximum conditions of pesticide or fertilizer application at Horning Seed Orchard.

Risk Management Approaches

If applications of these pesticides were prescribed, risks to wildlife species could be mitigated by measures such as decreasing the application rate, decreasing the area

treated, decreasing the number of applications, and increasing the distance to streams from treated areas. Field surveys could also be used to determine whether some special status species that were evaluated are actually present on the seed orchard grounds, in on-site streams, or in downstream drainages.

Uncertainties

The risks summarized in this assessment are not probabilistic estimates of risk, but are conditional estimates. That is, these risks are likely only if all exposure scenario assumptions that were described are met. In addition, the methodology applied to estimating risks is not definitive, since uncertainty in the final risk estimates is introduced in almost every step of the assessment. Some of the primary areas of uncertainty are as follows:

- The information on each terrestrial species' range, diet, and other characteristics, compared to the characteristics it exhibits at the specific time of year when any particular application may be made.

- The LD_{50}s and LC_{50}s selected for use in the risk assessment, which are often drawn from data on species related to the species of interest, and not from tests on the species of interest itself.

- The necessity of using model-defined inputs and site-characterizing assumptions to depict the seed orchard and management activities for conducting the runoff, drift, and accidental spill modeling; as well as the accuracy of the models themselves, which provide an estimate of the impacts that could occur for purposes of prospective program evaluation, mitigation design, and alternative comparison, but are not able to be as accurate as data obtained from actual monitoring.

C.2.4 References Cited

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Attachment
Proposed Application Methods

Pesticides may be applied using several methods. For some pesticides, different combinations of pesticide and application method are being proposed, to give the seed orchard flexibility in addressing the specific management needs that may occur, including:

- aerial, using helicopter
- airblast sprayer
- high-pressure hydraulic sprayer
- hydraulic sprayer with hand-held wand
- tractor-pulled spray rig with boom
- backpack sprayer
- capsule implantation
- granular spreaders
- hand sprayer
- chemigation
- total-release canister
- greenhouse effluent irrigation
- hand-held wick
- injection

Each method is described briefly in the following paragraphs.

Aerial Application

A helicopter is equipped with a pesticide tank for aerial application of liquid mixtures. The size and type of helicopter may vary; however, a standard representation of its application equipment is used in the risk assessment, based on the local contractor's current equipment. Aerial application may be used to apply the insecticide esfenvalerate to active orchard units.

Airblast Sprayer

Airblast sprayers are pulled behind a tractor or a truck. Airblast sprayers use fans or blowers to propel spray mixtures into dense foliage or the tops of trees. The nozzles of airblast sprayers are positioned in the air stream to break up spray droplets and propel them into the tree tops. At Horning, an airblast sprayer may be used to apply the insecticides chlorpyrifos, esfenvalerate, or permethrin to orchard units.

High-Pressure Hydraulic Sprayer

High-pressure hydraulic sprayers consist of a powered pump and tank carried by truck or tractor, and hand-held nozzles for dispersing the solution upward into the tree. These sprayers could be used to treat individual mature trees with the insecticides acephate, diazinon, dimethoate, esfenvalerate, permethrin, horticultural oil, or propargite; or with the fungicide chlorothalonil.

Hydraulic Sprayer with Hand-Held Wand

A spray tank is mounted on a truck, tractor, or all-terrain vehicle, and may be used to treat young trees; and to apply herbicides around trees in orchard units, along fencelines, and as a spot treatment in fallow fields, orchard units, and administrative areas. The sprayer may be operated by one worker, who drives and stops to spray; or by two workers, with one driving and the other spraying. This method may be used to apply

the insecticides acephate or esfenvalerate, the fungicide propiconazole, or the herbicides glyphosate, triclopyr, hexazinone, picloram, or dicamba.

Tractor-Pulled Spray Rig with Boom

This method may be used to apply herbicides for control of weeds in orchard units, in roadways, or in fallow areas. Equipment consists of a hydraulic spray tank pulled by a tractor or heavy-duty pickup truck, with a spray boom attached to the tank to release the herbicide. At Horning, this method may be used to apply the herbicides glyphosate, hexazinone, or dicamba; or the fungicide propiconazole.

Backpack Sprayer

A backpack sprayer consists of a plastic tank that is strapped to the applicator's back. A hand-operated hydraulic pump forces the liquid from the tank through a nozzle in a hand-held wand. At Horning, a backpack sprayer could be used to apply the insecticide esfenvalerate; or the herbicides glyphosate, picloram, or triclopyr for spot treatment of unwanted vegetation in orchard units and along fencelines.

Capsule Implantation

The insecticide acephate may be implanted into individual trees for long-term control of insect pests in the form of a capsule. One small hole is drilled into a tree for every 4 inches of its circumference, and a capsule is inserted.

Granular Spreaders

Granular fertilizers or the granular fumigant dazomet may be distributed over the ground using a spreader pulled by a truck or tractor, or mounted on an all-terrain vehicle. Broadcast or sidecast spreaders would be used for general fertilizer (nitrogen/ phosphorus/sulfate) applications. Sidecast or drop spreaders would be used to apply calcium nitrate to the dripline of trees for stimulating flower production. A broadcast spreader would be used to apply the fumigant dazomet, after which the granules would be incorporated to a depth of four to eight inches, depending on targets to be controlled (e.g., annual weeds, specific soil-borne pathogens). Fertilizer application needs and rates for each orchard unit are determined based on the results of annual foliar analyses.

Hand Sprayer

A hand sprayer consists of a one- to two-gallon plastic container with a hand-operated trigger and wand. A hand sprayer may be used to apply the insecticide acephate or the fungicides chlorothalonil, mancozeb, and thiophanate-methyl in the greenhouse

Chemigation

Chemigation is the process of injecting pesticide into the irrigation system, so that it is applied with the irrigation water. At Horning, chemigation is only used in the greenhouse. This method may be used to apply the fungicides chlorothalonil, hydrogen dioxide, mancozeb, or thiophanate-methyl to greenhouse plants. For foliar applications such as these, the pesticide is added to the irrigation water at the end of the irrigation cycle, to minimize washoff and maximize efficacy.

Total-Release Canister

One formulation of the insecticide acephate may be used in the greenhouse in the form of total release canisters, or "foggers." The cans are placed evenly throughout

the greenhouse, and a tab release is pressed. The greenhouse is evacuated. The entire contents of each can are released automatically.

Greenhouse Effluent Irrigation

The effluent from greenhouse operations will be collected in a holding tank. This effluent will consist of excess irrigation water, including washoff containing greatly diluted residues of the fertilizers and pesticides used in the greenhouses. Greenhouse pesticides are acephate, chlorothalonil, hydrogen dioxide, mancozeb, and thiophanate-methyl. A typical effluent irrigation amount is estimated to be 4,800 gallons over 3 hours. The maximum volume is estimated to be 9,600 gallons in two 3-hour increments. Typical irrigation frequency is estimated to be every 2 to 3 days in summer and every 5 to 6 days in spring, fall, and early winter. The effluent will be irrigated over field B11.

Hand-Held Wick

A wick applicator consists of a hand-held stick containing diluted herbicide in contact with an absorbent material (a rope or wiper pad), which is then wiped directly on the foliage of target vegetation. At Horning, this method may be used to apply the Rodeo® formulation of glyphosate to individual weed plants.

Injection

Injection application consists of injecting herbicide directly into the interior of an individual undesirable plant. At Horning, this method may be used to apply the Rodeo® formulation of glyphosate.

Appendix D: Risk Analysis of Sublethal Effects for Special Status Aquatic Species

D.1 Methodology

In the non-target species risk assessment (summarized in Appendix C), it was postulated that species of fish may be exposed to pesticides or fertilizers through contaminated surface runoff or from drift during application. For each chemical, acute lethality data were evaluated for a representative species, the rainbow trout. Based on this information, mortality risks were also evaluated for one special status species known to be present in the Clear Creek and Milk Creek watersheds: the steelhead trout. Three additional special status aquatic species (chinook and coho salmon, Pacific lamprey) are located in the watershed; however, acute risks were not quantified for these species in the risk assessment, due to lack of information on populations of coho salmon and Pacific lamprey, and to the distance from the seed orchard of chinook salmon (more than 10 miles downstream), which is associated with a negligible potential for measurable mortality impacts. These additional special status species are, however, included in this assessment of the potential for sublethal effects.

In the quantitative aquatic species risk assessment, if data were available for sublethal or long-term toxic effects, a maximum acceptable toxicant concentration (MATC) was determined. The MATC is the geometric mean of a no-observable-effect concentration (NOEC) and a lowest-observed-effect concentration (LOEC). This further analysis of risks to special status aquatic species expands upon the MATC approach by estimating risks that are relevant to the biological requirements of the animal: in this case, survival, rearing and migration, and reproductive endpoints.

The *assessment endpoints* used to characterize potential sublethal effects reflect measures of the animal's health that can be functionally related to survival, migratory, or reproductive success (Washington State Pesticide/ESA Task Force 2001). The attributes of the assessment endpoints are termed *assessment measures*, which are defined by a *quantifiable measure* (EPA 1998a). For example, reduced swimming speed (quantifiable measure) can increase susceptibility to predation (assessment measure) which can ultimately threaten survival (assessment endpoint). Since $1/20^{th}$ of the acute lethality (LC_{50}) value has been presumed to be protective of sublethal effects in threatened and endangered fish species (EPA 1986a, EPA 1999a), it has been included here as a "sublethal survival" endpoint.

Since relatively few scientific studies have examined sublethal effects of pesticides on fish physiology or behavior, the selection of assessment endpoints is limited by available scientific and commercial literature. In the absence of data specific to the identified species of concern, data from biologically and genetically similar surrogate species are used. Comparative toxicology has demonstrated that various species of scaled fish generally have equivalent sensitivity (within an order of magnitude) to other species tested under the same conditions. Dwyer et al. (1995) and Beyers et al. (1994) have shown that some species of threatened and endangered fish are similarly sensitive to some classes of pesticides and other chemicals as their non-endangered counterparts. Very few studies have investigated the effects of pesticides specific to the lamprey, so comparative toxicity with fish species from available literature is made cautiously. In some cases, in the absence of pesticide-specific data for a fish species, data for pesticides that are chemically similar and share a common mechanism of toxicity were substituted.

For the purpose of broadening and strengthening the best available science for this evaluation, and simplifying the presentation of information, the proposed-use chemicals

are analyzed by chemical groups. The insecticides and acaricides are divided by chemical classes (biologicals, organophosphates, organosulfates, and pyrethroids), reflecting the common mechanism of action for each class. The herbicides and fungicides/fumigants are evaluated as groups, based on the most sensitive toxicity findings. Pesticides that do not fit in specific categories are grouped as "other pesticides". The other pesticides, "other" (formerly "inert") ingredients, and fertilizers are evaluated within their respective groups. In each case, the lowest toxicity result (indicating greatest toxicity) was used in the analysis of risks, so that this categorization approach would not sacrifice a protective analysis.

D.2 Literature Review of Toxicity Data

D.2.1 Insecticides and Acaricides

Biological

This group includes the insecticide *Bacillus thuringiensis* (*B.t.*).

The mode of action for *B.t.* is a disruption of the digestive tract. After an insect ingests a crystal of *B.t.*, the biopesticide dissolves in the alkaline gut. The toxin that is released binds to the lining of the midgut membrane, creating pores and upsetting ion balance. A similar mechanism of toxicity is assumed for fish.

Table D-1 lists relevant assessment endpoints and effect concentrations of *B.t.* to fish species as identified from the literature.

B.t. is practically nontoxic to aquatic vertebrate species, and only one identified study has investigated sublethal effects relevant to the assessment endpoints and measures for the essential biological requirements of special status fish species. Field observations

Table D-1. Effects of *Bacillus thuringiensis* on Fish Species

Assessment Endpoints	Assessment Measures	Species	Formulation	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50}[b]	rainbow trout	HD-1	> 112	Abbott Laboratories 1982
mortality	1/20 LC_{50}[b]	bluegill	HD-1	> 200	Abbott Laboratories 1982
mortality	1/20 LC_{50}[b]	European eel	HD-1	200 - 400 times field rates	Abbott Laboratories 1982
mortality	1/20 LC_{50}[b]	trout	israelensis	75 - 100	Merritt 1999
Migration					
NA[c]					
Reproduction					
Success	population (number)	brook trout	HD-1	typical aerial application	Abbott Laboratories 1982

[a] Lowest-observed-effect concentration. Shaded values are used in the final risk evaluation
[b] Adjusted 24-hour value.
[c] NA = Not available.

of populations of brook trout, common white suckers, and smallmouth bass found no adverse effects to populations one month after an aerial application of the *B.t.* HD-1 formulation (Abbott Laboratories 1982).

B.t. israelensis was tested for possible impacts on non-target invertebrates. Its use over a three-year period did not disturb the prey base of fish. No negative impacts were observed on invertebrate predators (Plecoptera, Odonata, Megaloptera, Trichoptera, Diptera) or grazers (Trichoptera, Ephemeroptera). Predators often consumed more *B.t.*-contaminated (dead) black fly larvae than live larvae with no adverse effects. Detritivores (mainly mayflies) consumed large amounts of *B.t.*-contaminated black fly larvae, resulting in increased body mass and shorter developmental times. Some Diptera species were sensitive to high doses of *B.t.* israelensis (>100 times the normal field dose) (Merritt 1999).

B.t. is moderately persistent in soils, with a half-life of about 4 months (Extoxnet 1996). In soils with a pH below 5.1, *B.t.* is rapidly inactivated. It does not tend to move, or leach, with groundwater. After 48 hrs, *B.t.* begins to inactivate in water, gradually settling out or adhering to suspended organic matter.

Organophosphates

This group includes the insecticides acephate, chlorpyrifos, diazinon, and dimethoate.

Organophosphate insecticides are highly toxic to fish. The primary mechanism of this toxicity is generally well understood, with inhibition of acetylcholinesterase (AChE) being the critical target. The function of AChE is to hydrolyze the neurotransmitter acetylcholine at synaptic junctions, terminating nervous stimulation. Inhibition of AChE is followed by an accumulation of acetylcholine, resulting in a continuous stimulation at cholinergic and muscarinic receptors. Relationships between AChE inhibition and biological function for fish have been investigated and include alterations in growth, reproduction, maturation, swimming, hyperactivity, and feeding. Organophosphate insecticides can target AChE located in the central and peripheral nervous system, and in the neuro-muscular junctions. Inhibition of AChE at these regions can affect behavioral processes, sensory systems, and swimming ability in fish.

Table D-2 lists relevant assessment endpoints and effect concentrations of acephate, chlorpyrifos, diazinon and dimethoate and other relevant organophosphates to salmonid species and the European eel.

Scholz et al. (2000) exposed juvenile chinook salmon to concentrations of diazinon ranging from 0.0001 to 0.010 mg/L for two hours and then allowed them to recover for one hour. After exposures, anti-predator behaviors were observed when skin extracts from juvenile salmon were added to the trial tanks. At concentrations of 0.001 and 0.010 mg/L, the fish failed to respond to the olfactory cue. Rainbow trout showed altered swimming patterns when exposed to diazinon for 24 to 96 hours, at concentrations ranging from 0.25 to 1.0 mg/L (Brewer et al. 2001).

The European eel, when exposed to diazinon or chlorpyrifos, exhibited signs of restlessness, erratic swimming, convulsions and difficulty in respiration at acutely toxic concentrations of 0.16 and 1.29 mg/L, respectively, after 24 hours (Ferrando et al. 1991). When rainbow trout were exposed to 0.01 mg/L methyl parathion for 96 hours, swimming activity decreased and the fish were more vulnerable to predation by bass. Of control fish, 84% survived predation, as opposed to 57% of the exposed fish (Little et al. 1990).

Table D-2. Effects of Organophosphates on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50} [b]	rainbow trout cutthroat trout brook trout	acephate	44.8 > 20.0 > 20.0	EPA 1984
mortality	1/20 LC_{50} [b]	rainbow trout cutthroat trout lake trout	chlorpyrifos	0.006 0.003 0.020	EPA 2000a
mortality	1/20 LC_{50} [b]	rainbow trout cutthroat trout lake trout	diazinon	0.018 0.34 0.12	Johnson and Finley 1980
mortality	1/20 LC_{50} [b]	brook trout	diazinon	0.15	Allison and Hermanutz 1977
mortality	1/20 LC_{50} [b]	European eel	diazinon	0.008	Sancho et al. 1992
mortality	1/20 LC_{50} [b]	European eel	chlorpyrifos	0.065	Ferrando et al. 1991
mortality	1/20 LC_{50} [b]	rainbow trout	dimethoate	1.24	EPA 1999b
predation	olfactory anti-predatory response (food strikes, activity)	chinook salmon	diazinon	0.001	Scholz et al. 2000
predation	swimming (distance, speed, turning rate, tortuosity of path)	rainbow trout	diazinon	0.250	Brewer et al. 2001
predation	survival (predation by Large mouth bass)	rainbow trout	methyl parathion[c]	0.01	Little et al. 1990
predation	swimming (erratic pattern)	European eel	diazinon	0.16	Ferrando et al. 1991
predation	swimming (erratic pattern)	European eel	chlorpyrifos	1.29	Ferrando et al. 1991
growth	foraging (prey ingestion)	Atlantic salmon	fenitrothion[c]	0.006	Morgan and Kiceniuk 1991

Table cont. on page D-6

Foraging behaviors were tested in Atlantic salmon exposed to fenitrothion for two 24-hour periods separated by seven days. At concentrations of 0.006 and 0.21 mg/L, the reaction distance of the salmon to respond to prey decreased significantly (Morgan and Kiceniuk 1991).

Exposure of juvenile Atlantic salmon to 0.1 mg/L fenitrothion for 15 to 16 hours caused a 20% decrease in the number of fish that were able to maintain and hold territories six days following treatments (Symons 1973). The territories were not reclaimed for approximately two to three weeks. Some severely affected fish swam stiffly and ceased feeding, but recovery to these effects was evident within 48 hours after returning to clean water. Coho salmon showed very similar behavioral changes over the same concentration range (Bull and McInerney 1974). When adult chinook salmon were treated with 0.010 mg/L diazinon and re-released downstream of their native hatchery, the number of returns was significantly lower than unexposed control fish.

Following a direct perfusion-exposure of diazinon directly over the olfactory epithelium, adult male Atlantic salmon showed inhibited olfactory stimulation in response to a female reproductive pheromone (Moore and Waring 1996). Concentrations of diazinon affecting olfactory sensitivity ranged from 0.001 to 0.02 mg/L. The same study found that diazinon exposures of 0.0003 to 0.045 mg/L reduced the production of reproductive hormones and viable sperm in the males when presented with the female priming pheromone.

Environmental factors may also influence organophosphate toxicity to aquatic species, altering effect estimates to the fish (Table D-3). A number of studies tested environmental effects on the toxicity of chlorpyrifos and azinphos-methyl to salmonids. Parameters included temperature, pH, water hardness, fish size, and static versus flow-through exposures. In general, acute toxicity of chlorpyrifos and azinphos-methyl were found to increase with temperature, pH, and body size of the fish. Increasing hardness tended to reduce the toxicity of chlorpyrifos, and static exposure tests produced lower lethality values than those from flow-through tests.

Organosulfites

This group includes the acaricide propargite.

EPA lists propargite as a probable human carcinogen, meaning there is a possibility of causing cancer in animals as well. Propargite is highly toxic to fish.

Table D-4 lists relevant assessment endpoints and effect concentrations of propargite to fish species as identified from the literature.

A chronic test in fathead minnows showed that propargite affected growth and survival at a concentration of 0.028 mg/L; the NOEC was 0.016 mg/L (EPA 2000b). Acute mortality data for the catfish are used in the risk evaluation for the survival endpoint, since this was the most sensitive endpoint identified.

For reproductive parameters, a chronic test in fathead minnows showed that propargite affected growth, survival, and day to hatch at a concentration of 0.028 mg/L; the NOEC was 0.016 mg/L (EPA 2000b).

No data are currently available for migratory effects endpoints or environmental influences on toxicity.

Table D-2. Effects of Organophosphates on Fish Species (continued)

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Migration					
upstream return	homing (number returning to hatchery)	chinook salmon	diazinon	0.010	Scholz et al. 2000
rearing	Territory defense (location)	Atlantic salmon	fenitrothion[c]	0.1	Symons 1973
rearing	territory defense (agonistic behaviors)	coho salmon	fenitrothion[c]	0.1	Bull and McInerney 1974
Reproduction					
mating	detection of mate (electrophysiology)	Atlantic salmon	diazinon	0.001	Moore and Waring 1996
physiology	biological stimulation (hormone production, expressible milt)	Atlantic salmon	diazinon	0.0003	Moore and Waring 1996

[a] Lowest-observed-effect-concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] Not proposed for use in seed orchard by BLM; data used for assessment purposes only.

Table D-3. Environmental Factors Influencing Organophosphate Toxicity to Fish

Environmental Factor	Assessment Measures	Species	Chemical	Reference
temperature	24-hr LC_{50} (2, 7, 13°C)	rainbow trout	chlorpyrifos	Macek et al. 1969
temperature	96-hr LC_{50} (2, 7, 13°C)	rainbow trout	chlorpyrifos	Macek et al. 1969
temperature	24-hr LC_{50} (2, 7, 13°C)	rainbow trout	azinphos-methyl[a]	Macek et al. 1969
temperature	96-hr LC_{50} (2, 7, 13°C)	rainbow trout	azinphos-methyl[a]	Macek et al. 1969
temperature	96-hr LC_{50} (2, 7, 13, 18°C)	rainbow trout	chlorpyrifos	EPA 2000a
pH	96-hr LC_{50} (7.5, 9.0)	cutthroat trout	chlorpyrifos	EPA 2000a
hardness	96-hr LC_{50} (44, 162 mg/L $CaCO_3$)	lake trout	chlorpyrifos	EPA 2000a
exposure system	96-hr LC_{50} (static, flow through)	lake trout	chlorpyrifos	EPA 2000a
body weight	96-hr LC_{50} (0.3 2.9 g)	lake trout	chlorpyrifos	EPA 2000a

[a] Not proposed for seed orchard use by BLM; data used for assessment purposes only.

Table D-4. Effects of Organosulfites on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	rainbow trout	propargite	0.024	EPA 2000b
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	bluegill	propargite	0.034	Uniroyal 1998
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	minnow	propargite	0.012	Uniroyal 1998
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	catfish	propargite	0. 008	Uniroyal 1998
growth	size (length, weight)	fathead minnow	propargite	0.028	EPA 2000b
Migration					
NA[c]					
Reproduction					
success	day to hatch (mean number)	fathead minnow	propargite	0.028	EPA 2000b

[a] Lowest-observed-effect-concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] NA = Not available.

Pyrethroids

The pyrethroid insecticide group includes esfenvalerate and permethrin.

Pyrethroids are highly toxic to fish, generally with acute LC_{50} values for salmonids near or below 0.001 mg/L. The mode of action for pyrethroids is the blocking of neural voltage-activated sodium/calcium channels, producing common symptoms of toxicity for the various synthetic compounds. The sensitivity of fish to pyrethroids, compared to other vertebrates, has been explained, in part, by the fishes' inability to metabolize and excrete the toxins (Haya 1989). A comparative study between steelhead trout and coho salmon showed that both species were similarly sensitive across the five pyrethroids tested (Mauck and Olson 1976). Thus, incorporating data from pyrethroids of similar toxicity across similar fish species should provide adequate estimates where salmonid data gaps are present.

Table D-5 lists relevant assessment endpoints and effect concentrations of esfenvalerate, permethrin, and other pyrethroids to fish species as identified from the literature. Note that the active isomer of fenvalerate is esfenvalerate.

Pyrethroids have been documented to affect behavior and physiology in fish important for survival. Sublethal effects observed in fish include alterations in growth, metabolic processes, swimming, a reduced startle response, loss of equilibrium, body tremors, and depressed olfactory sensitivity.

Juvenile Atlantic salmon exposed to 0.008 mg/L fenvalerate were unable to survive the stress of hunger over a 70-hour period, with mortality resulting in over half of the test animals (Haya 1989). Growth was reduced in sheepshead minnow fry exposed to fenvalerate concentrations $\geq$ 0.002 mg/L over a period of 28 days (Hansen et al. 1983).

Table D-5. Effects of Pyrethroids on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	rainbow trout	esfenvalerate	0.001	Du Pont 1999
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	steelhead trout	fenvalerate	0.00035	Curtis et al. 1985
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	rainbow trout	permethrin	0.0043	Mayer and Ellersieck 1986
growth	feeding (mortality from stress)	Atlantic salmon	fenvalerate	0.008	Haya 1989
growth	size (length, weight)	sheepshead minnow	fenvalerate	0.002	Hansen et al. 1983
predation	swimming (tremors)	bluegill	esfenvalerate	0.000025	Little et al. 1993
predation	swimming (critical speed)	rainbow trout	permethrin	0.00075	Kumaraguru et al. 1982
predation	avoidance behavior (startle response)	Japanese medaka	permethrin	0.009	Rice et al. 1997
predation	behavior (equilibrium, coughing)	rainbow trout	permethrin	0.0013	Holcombe et al. 1982
Migration					
behavior	schooling (location, grouping pattern)	fathead minnow	permethrin	0.007	Holcombe et al. 1982
rearing	territory defense (aggression)	bluegill	esfenvalerate	0.0001	Little et al. 1993
Reproduction					
mating	detection of mate (electrophysiology)	Atlantic salmon	cypermethrin[c]	0.00001	Moore and Waring 2001
physiology	biological stimulation (hormone production, expressible milt)	Atlantic salmon	cypermethrin[c]	0.000004	Moore and Waring 2001
success	recruits (number per female)	bluegill	esfenvalerate	0.00067	Fairchild et al. 1992
success	egg hatch (number) larvae survive (number) larvae abnormality (deformities)	Australian crimson-spotted rainbowfish	esfenvalerate	0.001 0.032 0.032	Barry et al. 1995

[a] Lowest-observed-effect concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] Not proposed for seed orchard use by BLM; data used for assessment purposes only.

Primary toxicity involves disruption to the neuromuscular system, affecting swimming and other coordinated muscular movement. Gross body tremors of juvenile bluegill continually or pulse-exposed to esfenvalerate were sensitive indicators of toxicity at concentrations as low as 0.000025 mg/L (Little et al. 1993). Rainbow trout exposed to 0.00075 mg/L permethrin showed a substantial decrease in swimming performance that was related to exposure duration, from one to 43 days (Kumaraguru and Beamish 1986). This effect was attributed to an increased metabolic rate and a higher demand in oxygen consumption. After a 24-hour exposure to >0.009 mg/L permethrin, Japanese medaka

were hypoactive and underreactive to startle stimuli (Rice et al. 1997). Rainbow trout exposed for 48 hours to permethrin at 0.0013 mg/L caused rapid gill movements and a pattern of swimming at the water surface (Holcombe et al. 1982).

Juvenile selection of rearing habitat, smolt outward migration, and adult homing are behaviors related to successful migration. Aggression of bluegill, a response of the fish to defend rearing territory, was significantly lower among fish exposed to pulsed 11-hour concentrations of 0.0001 mg/L esfenvalerate (Little et al. 1993). Schooling behavior of fathead minnows was affected at 0.0072 mg/L permethrin (Holcombe et al. 1982).

Following a five-day exposure to 0.00001 mg/L cypermethrin (nominal concentration), male Atlantic salmon showed inhibited olfactory stimulation to a female reproductive pheromone (Moore and Waring 2001). The same study found that exposures < 0.000004 mg/L reduced biochemical responses to the pheromone and caused a reduction of viable sperm produced.

Barry et al. (1995) studied the effects of esfenvalerate exposure to the Australian crimson-spotted rainbowfish over a period of six days. At 0.001 mg/L, there was a significant decrease in the number of larvae hatching per spawning day. Hatchability of eggs was affected and there was an increase in abnormalities in larvae at a concentration of 0.032 mg/L. In an aquatic mesocosm study of esfenvalerate on bluegill, reproductive success, as defined by the number of offspring per female, was decreased at a concentration of 0.00067 mg/L (Fairchild et al. 1992).

Environmental factors may also influence pyrethroid toxicity to aquatic species, altering effect estimates to fish (Table D-6). Pyrethroid insecticides readily bind to organic matter in the soil, have little mobility, and are practically insoluble in water. When caged rainbow trout were exposed to cypermethrin in a pond containing 14 to 22 mg/L suspended solids, the amount of pesticide necessary to result in mortality increased by nearly five times (from 0.001 to 0.005 mg/L) (Shires 1983). Rainbow trout became more sensitive to permethrin with increasing water temperature (Kumaraguru and Beamish 1986). The 96-hour LC_{50} values decreased by nearly an order of magnitude (0.0064 to 0.00069 mg/L) between 10 and 20 °C, respectively. Toxicity of four pyrethroids to coho salmon and steelhead trout was not influenced by pH in the range of 6.5 to 9.5, or by water hardness ranging from 10 to 300 mg/L $CaCO_3$ (Mauck and Olson 1976).

Table D-6. Environmental Factors Influencing Pyrethroid Toxicity to Fish

Environmental Factor	Assessment Measures	Species	Chemical	Reference
turbidity	96-hr LC_{50} (suspended solids)	rainbow trout	cypermethrin[b]	Shires 1983
temperature	96-hr LC_{50} (5 - 25°C)	rainbow trout	permethrin	Kumaraguru et al. 1982
hardness[a] pH	96-hr LC_{50} (10 - 300) 96-hr LC_{50} (6.5 - 9.5)	coho salmon steelhead trout	dimethrin[b] d-trans allethrin[b] RU-11679[b] s-bioallethrin[b]	Mauck and Olson 1976

[a] As mg/L $CaCO_3$.
[b] Not proposed for seed orchard use by BLM; data used for assessment purposes only.

D.2.2 Herbicides

The herbicides evaluated are dicamba, glyphosate, hexazinone, picloram, and triclopyr.

Classification of herbicides by chemical structure for evaluating toxic effects in fish is not practical because the mechanism by which herbicides elicit toxicity in animals is non-specific, with a broad overlapping of biological effects. Another method is to classify herbicides by their acute toxicity to fish as presented below. One proposed-use herbicides is classified as very highly or highly toxic to fish. Two herbicides are considered moderately or slightly toxic to fish. Three herbicides are considered practically non-toxic to fish.

- Very highly (<0.1 mg/L) and highly toxic (0.1 to 1.0 mg/L) to fish: triclopyr butoxyethyl ester.
- Moderately (1.0 to 10 mg/L) and slightly toxic (10 to 100 mg/L) to fish: picloram and dicamba.
- Practically non-toxic (>100 mg/L) to fish: glyphosate, hexazinone, triclopyr-triethylamine salt.

Herbicides do not typically elicit a specific mechanism of toxicity to fish. Toxicity is often associated with skin and eye irritations, nausea, hemorrhages, and kidney and liver inflammation in mammals which can eventually lead to mortality. The gill, liver, and kidneys are often the target organs for herbicides in fish.

Table D-7 lists relevant assessment endpoints and effect concentrations of dicamba, glyphosate, hexazinone, picloram, and triclopyr to fish species as identified from the literature.

Based on available information, chronic picloram toxicity to fish is not cumulative in terms of lethality (Woodward 1976). However, long-term exposures have been shown to affect fish development and growth. It was observed that the NOEC of technical grade picloram for lake trout was apparently <0.035 mg/L, as this level of herbicide reduced fry survival and growth. Most abnormalities occurred during yolk absorption, which took four to five days longer in picloram-treated fish. Morgan and Kiceniuk (1992) observed no effects of glyphosate exposure on growth and weight, or foraging activities at concentrations up to 0.1 mg/L for 1-2 months. In an early lifestage test for hexazinone using the fathead minnow, a NOEC of 17 mg/L was determined, with fish length affected at the LOEC of 35.5 mg/L (EPA 1994).

The toxicity of triclopyr (butoxyethyl ester) at a concentration lower than 0.56 mg/L reduced spontaneous swimming activity in coho salmon after 96-hour exposures (Johansen and Geen 1990). At concentrations lower than 0.10 mg/L, fish were very sensitive to stimuli. At slightly higher concentrations, they were initially sensitive prior to reaching a pronounced state of lethargy. It was suggested that the formulation affected the nervous system of the fish.

There was no effect of dicamba on gill ATPase activity of coho salmon exposed up to 100 mg/L for 144 hours (Lorz et al. 1979). (ATPase is an enzyme that is needed for energy-requiring cellular activities to take place.) Histological examination of gill, liver, and kidney tissue indicated no apparent effects. When challenged with seawater, fish previously exposed to the lowest level of 0.25 mg/L showed a 32% mortality during the 11 days of the test. When coho salmon were treated with picloram at 0.25 mg/L for 144 hours, 25% mortality occurred. Inexplicably, no deaths occurred at the higher

Table D-7. Effects of Herbicides on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50}[b]	rainbow trout	dicamba	1.8	Mayer and Ellersieck 1986
mortality	1/20 LC_{50}[b]	cutthroat trout	dicamba	10	Caux et al. 1993
mortality	1/20 LC_{50}[b]	coho salmon	dicamba	5.5 (6-day)	Caux et al. 1993
mortality	1/20 LC_{50}[b]	cutthroat trout	dicamba/ picloram mixture	10	Woodward 1982
mortality	1/20 LC_{50}[b]	rainbow trout	glyphosate	1.6	EPA 1993a
mortality	1/20 LC_{50}[b]	chinook salmon	glyphosate	1.9	Mitchell et al. 1987
mortality	1/20 LC_{50}[b]	coho salmon	glyphosate	2.2	Mitchell et al. 1987
mortality	1/20 LC_{50}[b]	sockeye salmon	glyphosate	5.3	Servizi et al. 1987
mortality	1/20 LC_{50}[b]	rainbow trout	hexazinone	16	Wan et al. 1988
mortality	1/20 LC_{50}[b]	coho salmon	hexazinone	14.5	Wan et al. 1988
mortality	1/20 LC_{50}[b]	chum salmon	hexazinone	16.1	Wan et al. 1988
mortality	1/20 LC_{50}[b]	chinook salmon	hexazinone	19.7	Wan et al. 1988
mortality	1/20 LC_{50}[b]	pink salmon	hexazinone	15.5	Wan et al. 1988
mortality	1/20 LC_{50}[b]	sockeye salmon	hexazinone	18.2	Wan et al. 1988
mortality	1/20 LC_{50}[b]	rainbow trout	picloram	0.16	Mayer and Ellersieck 1986
mortality	1/20 LC_{50}[b]	cutthroat trout	picloram	0.17	Mayer and Ellersieck 1986
mortality	1/20 LC_{50}[b]	lake trout	picloram	0.09	Mayer and Ellersieck 1986
mortality	1/20 LC_{50}[b]	cutthroat trout	picloram/ dicamba mixture	0.8	Woodward 1982
mortality	1/20 LC_{50}[b]	rainbow trout	triclopyr (triethylamine salt)	47.4	EPA 1998b
mortality	1/20 LC_{50}[b]	rainbow trout	triclopyr (BEE)[c]	0.033	EPA 1998b
mortality	1/20 LC_{50}[b]	chinook salmon	triclopyr (BEE)[c]	0.088	Kreutzweiser et al. 1994
mortality	1/20 LC_{50}[b]	coho salmon	triclopyr (BEE)[c]	0.052	Mayes et al. 1986

Table D-7. Effects of Herbicides on Fish Species (continued)

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
growth	size (length, weight)	cutthroat trout	picloram	0.61	Woodward 1979
growth	size (length, weight)	lake trout	picloram	0.035	Woodward 1976
growth	size (length, weight)	rainbow trout	glyphosate	0.046 (NOEC)	Morgan and Kiceniuk 1992
growth	foraging (rearing distance, attacks, captures, ingestion)	rainbow trout	glyphosate	0.046 (NOEC)	Morgan and Kiceniuk 1992
growth	size (length)	fathead minnow	hexazinone	35.5	EPA 1994
fitness	hypersensitivity to stimuli	coho salmon	triclopyr (BEE)[c]	0.10	Johansen and Geen 1990
fitness	lethargic (spontaneous activity)	coho salmon	triclopyr (BEE)[c]	0.32	Johansen and Geen 1990
Migration					
rearing	territory defense (agonistic behaviors)	rainbow trout	glyphosate	0.046 (NOEC)	Morgan and Kiceniuk 1992
adaptation	osmoregulation (gill lesions)	rainbow trout	glyphosate	0.046 (NOEC)	Morgan and Kiceniuk 1992
adaptation	sea water challenge (mortality)	coho salmon	dicamba	0.25	Lorz et al. 1979
adaptation	sea water challenge (mortality)	coho salmon	picloram	0.25	Lorz et al. 1979
adaptation	sea water challenge (mortality)	coho salmon	glyphosate	2.8 (NOEC)	Mitchell et al. 1987
Reproduction					
success	fecundity (egg number) gonadosomatic index (gonad/body)	rainbow trout	glyphosate	2.0 (NOEC)	Folmar et al. 1979
success	larval survival (number)	rainbow trout	picloram	2.0	Mayes et al. 1987

[a] Lowest-observed-effect concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] BEE - butoxyethyl ester

exposure concentrations for both herbicides. There was no apparent effect of picloram on the ATPase activity of the gills. Histological examination of fish exposed to 5.0 mg/L revealed abnormal liver and gill tissues. Mitchell et al. (1987) exposed coho salmon to glyphosate for 10 days at concentrations up to 2.8 mg/L, with no effect on successful seawater adaptation.

Rainbow trout exposed for two months to glyphosate had no significant increase in gill lesions, and fish did not show any change in agonistic activity that would be important for territorial defense (Morgan and Kiceniuk 1992).

Rainbow trout exposed up to 2.0 mg/L glyphosate for 12 hr showed no effect on fecundity (eggs per female) and gonadosomatic index (gonad weight/total body weight) (Folmar et al. 1979). Tests with the early lifestages of rainbow trout showed that picloram concentrations of 2 mg/L reduced survival of the larvae (Mayes et al. 1987).

Environmental factors may influence herbicide toxicity to aquatic species, altering the effect estimates to fish (Table D-8). Glyphosate toxicity to rainbow trout increased with higher test temperatures (Folmar et al. 1979). Toxicity increased from pH 6.5 to 7.5, but did not change up to pH 9.5. Increasing temperature and pH with exposures to picloram resulted in greater toxicities to cutthroat trout and lake trout (Woodward 1976). The specific content of $CaCO_3$ in the tested "soft", "hard", and "very hard" waters was not specified, but were reported not to alter toxicity. Eyed eggs were the least sensitive lifestage, with toxicity increasing markedly as the fish entered the sac fry and early swim-up stages.

D.2.3 Fungicides and Fumigants

The fungicides and fumigants group include dazomet, chlorothalonil, mancozeb, propiconazole, and thiophanate-methyl.

Classification of fungicides and fumigants by chemical structure for evaluating toxic effects in fish is not practical because the mechanism by which they elicit toxicity in animals is non-specific, with a broad overlapping of biological effects. Unlike the herbicides, fumigants and fungicides can be highly toxic to animals. The same classification method used for the herbicides can be applied to fungicides and fumigants based on the acute toxicity to fish. Three of the proposed-use fungicides and fumigants are classified as very highly or highly toxic to fish. Two are considered moderately or slightly toxic to fish.

- Very highly (<0.1 mg/L) and highly toxic (0.1 to 1.0 mg/L) to fish: dazomet, chlorothalonil, mancozeb.

- Moderately (1.0 to 10 mg/L) and slightly toxic (10 to 100 mg/L) to fish: propiconazole, thiophanate-methyl.

Table D-8. Environmental Factors Influencing Herbicide Toxicity to Fish

Environmental Factor	Assessment Measure	Species	Chemical	Reference
temperature	96-hr LC_{50} (7 - 17°C)	rainbow trout	glyphosate	Folmar et al. 1979
temperature	96-hr LC_{50} (5 - 15°C)	cutthroat trout	picloram	Woodward 1976
temperature	96-hr LC_{50} (5 - 15°C)	lake trout	picloram	Woodward 1976
pH	96-hr LC_{50} (6.5 - 9.5)	rainbow trout	glyphosate	Folmar et al. 1979
pH	96-hr LC_{50} (6.5 - 8.5)	cutthroat trout	picloram	Woodward 1976
pH	96-hr LC_{50} (6.5 - 8.5)	lake trout	picloram	Woodward 1976
hardness[a]	96-hr LC_{50} ("soft", "hard", very hard")	cutthroat trout	picloram	Woodward 1976
hardness[a]	96-hr LC_{50} ("soft", "hard", very hard")	lake trout	picloram	Woodward 1976
lifestage	96-hr LC_{50} (eyed eggs, sac fry, swim up fry, fingerling 1.0g, fingerling 2.0g)	rainbow trout	glyphosate	Folmar et al. 1979

[a] Content of $CaCO_3$ not specified.

- Practically non-toxic (>100 mg/L) to fish: none.

All fungicides and most fumigants produce positive results in the usual microbial mutagenicity test systems (Ecobichon 1996). The microorganisms (salmonella, coliforms, yeasts, and fungi) used in these test systems are similar to those cell systems that fungicides were designed to target. It is possible that the fungicides and fumigants are mutagenic to higher animals as well.

Table D-9 lists relevant assessment endpoints and effect concentrations of dazomet, chlorothalonil, mancozeb, propiconazole, and thiophanate-methyl to fish species as identified from the literature.

Caux et al. (1996) reported a chronic 21-day LOEC for chlorothalonil of 0.0049 mg/L for rainbow trout with mortality as the endpoint.

A full life-cycle aquatic toxicity test with chlorothalonil resulted in a NOEC of 0.003 mg/L in fathead minnows, with hatching success and survivability affected at the LOEC of 0.0065 mg/L (EPA 1999a).

In a brown trout early lifestage test with propiconazole, a LOEC of 1.0 and 3.0 mg/L were determined for survival and hatching, respectively (Grande et al. 1994).

No data are currently available relevant to migratory effects or environmental influences on toxicity.

Table D-9. Effects of Fungicides and Fumigants on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50}[b]	rainbow trout	chlorothalonil	0.0085	EPA 1999a
mortality	1/20 LC_{50}[b]	rainbow trout	dazomet	0.032	BASF 1999
mortality	1/20 LC_{50}[b]	rainbow trout	dazomet	0.48	USDA 1998
mortality	1/20 LC_{50}[b]	brook trout	dazomet	2.0	USDA 1998
mortality	1/20 LC_{50}[b]	rainbow trout	mancozeb	0.092	EPA 1987
mortality	1/20 LC_{50}[b]	rainbow trout	propiconazole	1.0	Novartis 2000
mortality	1/20 LC_{50}[b]	brown trout	propiconazole	0.24	Grande et al. 1994
mortality	1/20 LC_{50}[b]	rainbow trout	thiophanate-methyl	1.7	EPA 1986b
survival	21-day mortality (1/20 LC_{50})	rainbow trout	chlorothalonil	0.0049	Caux et al. 1996
Migration					
NA[c]					
Reproduction					
success	hatching (number, survivability)	fathead minnow	chlorothalonil	0.0065	EPA 1999a
success	hatching (number) hatching (survivability)	brown trout	propiconazole	3.0 1.0	Grande et al. 1994

[a] Lowest-observed-effect concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] NA = No data available.

D.2.4 Other Pesticides

The pesticides hydrogen dioxide and horticultural oil do not fit within the previously assessed categories.

No mortality or indications of toxicity were observed in 96-hour studies in which rainbow trout, bluegill sunfish, and juvenile rainbow trout were exposed to horticultural oil at a concentration of 100 mg/L (Valent USA 1983, Wildlife International 1991). Although no LC_{50} values were determined, the value of 100 mg/L was used as the toxicity data point for fish species in the risk assessment, due to the lack of additional exposure-response information.

Hydrogen dioxide is a synonym for hydrogen peroxide. Peroxy compounds such as hydrogen peroxide are unstable and short-lived in the environment, quickly breaking down to water and oxygen (EPA 1993b). Hydrogen peroxide was evaluated for use in controlling external pathogenic bacteria and parasites in fish hatcheries (Gaikowski et al. 1999). The NOEC for 90% survival of Atlantic salmon, lake trout, and rainbow trout over eight days following a one- to three-hour exposure ranged from 112 to 429 mg/L. Another study reported increased hatch (attributed to fungicidal properties) compared to controls in eggs of cool-water fish treated five days per week for 15 minutes with hydrogen peroxide at a concentration of 1 mL/L (1.44 mg/L); higher concentrations were associated with progressive decreases in hatching success. Species tested were northern pike, walleye, yellow perch, white sucker, lake sturgeon, paddle fish, common carp, and channel catfish (Rach et al. 1998).

No data are currently available on migratory or reproductive endpoints, or environmental influences on toxicity.

D.2.5 "Other" Ingredients

In addition to active ingredients, pesticide products contain a certain percentage of "other" ingredients (previously termed "inert" ingredients), which enhance the action of the active ingredient. Other ingredients can include surfactants, carriers, or preservatives. Some of the formulations proposed for use contain one or more of the following other ingredients: cyclohexanone, ethylbenzene, light aromatic solvent naphtha, and xylene.

Cyclohexanone, ethylbenzene, naphthalene (as an example of a light aromatic solvent naphtha), and xylene are hydrocarbons with solvent properties, having broad toxicological effects in fish. However, the primary target for acute exposure appears to be the gills.

Xylene occurs in three isomers which vary in the site of attachment on the benzene ring of the two methyl groups. Technical xylene typically contains mixed proportions of *o*-, *m*-, and *p*- isomers, with varying toxicity to fish. For the purposes of this assessment, all xylene isomers will be regarded as xylene.

Table D-10 lists relevant assessment endpoints and effect concentrations of cyclohexanone, ethylbenzene, light aromatic solvent naphtha, and xylene to fish species as identified from the literature.

Morrow et al. (1975) found that 100 mg/L xylene killed 100% of young coho salmon, and that 1 to 10 mg/L caused no significant mortality. Toxic symptoms before death included rapid, violent and erratic swimming, "coughing", and loss of equilibrium. Rainbow trout exposed to 3.2 and 6.2 mg/L xylene for 2 hours showed symptoms similar to anesthesia (Walsh et al. 1977).

Table D-10. Effects of Other Ingredients on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50}[b]	fathead minnow	cyclohexanone	96.2	HSDB 2001
mortality	1/20 LC_{50}[b]	rainbow trout	cyclohexanone	30.3 - 75.7	EPA 2001
mortality	1/20 LC_{50}[b]	rainbow trout	ethylbenzene	14	Mayer and Ellersieck 1986
mortality	1/20 LC_{50}[b]	rainbow trout	naphtha (as naphthalene)	0.32 - 1.1	EPA 2001
mortality	1/20 LC_{50}[b]	coho salmon	naphtha (as naphthalene)	0.64	Eisler 1987
mortality	1/20 LC_{50}[b]	rainbow trout	xylene	0.42 - 0.68	Mayer and Ellersieck 1986
survival	predation (erratic swimming, equilibrium, breathing)	coho salmon	xylene	100	Morrow et al. 1975
survival	predation (equilibrium)	rainbow trout	xylene	3.2	Walsh et al. 1977
Migration					
rearing	olfaction (avoidance behavior)	rainbow trout	xylene	0.1	Folmar 1976
rearing	olfaction (avoidance behavior)	coho salmon	xylene	0.2	Maynard and Weber 1981
Reproduction					
success	fertilization (rate, cell cleavage)	cod	xylene	8.0 - 35	Kjorsvic et al. 1982

[a]Lowest-observed-effect-concentration. Shaded values are used in the final risk evaluation.
[b]Adjusted 24-hour value.

Rainbow trout significantly avoided xylene at a nominal concentration of 0.1 mg/L during a one-hour test (Folmar 1976). Fish exposed to 0.001 mg/L did not show significant avoidance and those exposed to 0.01 mg/L were significantly attracted to the xylene. Maynard and Weber (1981) found that juvenile coho salmon avoided *o*-xylene at concentrations greater than 0.2 mg/L.

Kjorsvic et al. (1982) exposed cod eggs to xylene isomers in covered glass dished and monitored the effects both during fertilization and during early cleavage of fertilized eggs. Both *m*-xylene and *p*-xylene induced significant decreases in the fertilization rate at concentrations above 10 mg/L. Effects on the early cleavage pattern were significant for xylene concentrations between 2 and 7 mg/L. Observed effects included inhibition of formulation of the cleavage furrow. Small cells or a total absence of cleavage occurred on exposure to all isomers at concentrations of 16 to 35 mg/L, while incomplete or uneven cleavage was found at exposures of 8 to 15 mg/L.

Because of rapid volatilization from water and soil to the atmosphere, chronic exposure to fish is unlikely. In the atmosphere, these compounds are readily degraded, primarily by photochemical processes (WHO 1996, WHO 1997).

D.2.6 Fertilizers

Fertilizers include ammonium nitrate, ammonium sulfate, monoammonium and diammonium phosphate, calcium nitrate, potassium nitrate, potassium chloride, potassium sulfate, and urea. The following paragraphs provide information of the toxicity of these fertilizers to fish species.

Table D-11 lists relevant assessment endpoints and effect concentrations of the proposed fertilizers to fish species, as identified from the literature.

In water, ammonium nitrate degrades to form ammonium and nitrate ions. In addition, ammonia is oxidized to nitrate by algae and bacteria. In water, the ammonium ion can exist in its ionized form (NH_4^+), and in its un-ionized form as ammonia (NH_3). The equilibrium between these two forms depends largely on pH and temperature. Ammonia demonstrates greater toxicity to aquatic species than does the ammonium ion, and this toxicity increases with decreases in pH and temperature.

Schuytema and Nebeker (1999a) identified a 10-day NOEC and LOEC for ammonium nitrate in Pacific tree frog tadpoles of 141 and 280 mg/L, respectively, based on decreased length and weight; corresponding values for the clawed toad were 280 and 569 mg/L. In a follow-on study of toxicity to the embryos of the same species, Schuytema and Nebeker (1999b) identified a 10-day NOEC and LOEC in Pacific tree frog embryos of 19 and 39 mg/L, and a 5-day NOEC and LOEC in clawed toad embryos of 19 and 39 mg/L. In an additional study, Schuytema and Nebeker (1999c) identified a 16-day ammonium nitrate NOEC and LOEC for embryos of the red-legged frog of 36.6 and 75.4 mg/L, respectively.

Table D-11. Effects of Fertilizers on Fish Species

Assessment Endpoints	Assessment Measures	Species	Fertilizer Component	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50}[b]	rainbow trout	ammonia (as NH_3)	0.11	Arthur et al. 1987
mortality	1/20 LC_{50}[b]	Atlantic salmon	ammonia (as NH_3)	0.0074 - 0.036	Knoph 1992
mortality	1/20 LC_{50}[b]	rainbow trout	nitrate (as NO_3)	2.0 (LC_{48})	Rouse et al. 1999
mortality	1/20 LC_{50}[b]	cutthroat trout	nitrate (as NO_3)	4.0 (LC_{41})	Rouse et al. 1999
mortality	1/20 LC_{50}[b]	rainbow trout	diammonium phosphate	93	Blahm and Snyder 1973
mortality	1/20 LC_{50}[b]	coho salmon	diammonium phosphate	49 - 64	HSDB 2001
mortality	1/20 LC_{50}[b]	bluegill	calcium nitrate	480	HSDB 2001
mortality	1/20 LC_{50}[b]	bluegill	potassium nitrate	38 - 105	EPA 2001
mortality	1/20 LC_{50}[b]	fathead minnow	potassium sulfate	49.5	EPA 2001
Migration					
NA[c]					
Reproduction					
NA					

[a] Lowest-observed-effect concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] NA = No data available.

Schuytema and Nebeker (1999a) identified a 10-day NOEC and LOEC for ammonium sulfate in Pacific treefrog tadpoles of 116 and 232 mg/L, respectively, based on decreased length; no adverse effects on length or weight were observed in the clawed toad at the highest concentration tested of 939 mg/L. In a follow-up study, the same investigators (Schuytema and Nebeker 1999b) identified a 10-day NOEC and LOEC in Pacific treefrog embryos of 58 and 110 mg/L, and a 5-day NOEC and LOEC in clawed toad embryos of 24 and 58 mg/L.

D.3 Effects Analysis

Based on the stream concentrations estimated by the risk assessment runoff and drift modeling, and the most sensitive assessment endpoints determined from the literature reviewed (as summarized in Section D.2 above), a sublethal effects risk evaluation was made. Data from the literature were evaluated to determine potential effects on some aspects of survival, migration, and reproduction, with the LOECs listed. From the listed data, the lowest LOEC from each of these three assessment endpoints was selected for the risk evaluation. The selected LOECs are not intended to be definitive of all possible adverse effects at all life-stages related to survival, migration, or reproduction, but are intended to be the most conservative, representative estimates available.

For each stream containing special status species at Horning, the highest typical and maximum pesticide concentrations modeled are identified, and are compared to the selected assessment endpoint LOECs. An effects ratio was determined, defined as the estimated pesticide concentration over the sublethal effect level. For example, if the stream concentration of a given chemical is estimated to be 0.003 mg/L, and the concentration of that chemical that affects reproduction is 0.006 mg/L, then the concentration-effect ratio would be 0.5—a moderate risk to the fish. Risks to some aspects of survival, migratory, and reproductive endpoints were determined to be low if the effects ratio was 0.1 or below, moderate if 0.1 to 1.0, and high if 1.0 or greater.

D.3.1 Insecticides and Acaricides

Biological

The risk assessment did not include fate and transport modeling for *B.t.*; therefore, expected concentrations in streams were not quantified. EPA has determined that risks from *B.t.* are minimal to non-existent for non-target aquatic organisms, including endangered species (EPA 1998c) (see Table D-1). The potential risks to the survival, migratory, and reproductive endpoints evaluated for special status species in all surface waters associated with Horning are therefore expected to be low for typical and maximum application scenarios.

Organophosphates

The potential risks to the evaluated sublethal endpoints are expected to be low for typical applications of acephate, chlorpyrifos, diazinon and dimethoate. For maximum applications of organophosphates, the potential risks to survival and migration in all streams are low, and reproductive risk is low in Swagger Creek, Milk Creek, and Clear Creek. However, in Nate Creek, the risk is moderate. This risk comparison is presented in Table D-12.

These estimates of risk may be influenced by environmental factors as previously discussed and presented in Section D.2.1, such as temperature, pH, hardness, and fish size. Organophosphate residues in surface runoff will likely be associated with the organic matter, reducing bioavailability of the pesticide. The only risks determined to be moderate were to reproductive endpoints.

Table D-12. Risks of Organophosphates to Special Status Fish

		Swagger Creek	Nate Creek	Milk Creek	Clear Creek
		Highest Estimated Surface Water Concentration (mg/L)[b]			
	typ: max:	*0.000000263* *0.0000154*	*0.00000103* *0.0000691*	*0.00000000166* *0.00000535*	*0.000000177* *0.0000099*
Assessment Endpoint (LOEC - mg/L[c])		**Concentration-Effect Ratio[a]**			
Survival (0.001)	typ: max:	0.00026 0.015	0.0010 0.069	0.000017 0.0054	0.00018 0.010
Migration (0.01)	typ: max:	0.000026 0.0015	0.00010 0.0069	0.0000017 0.00054	0.000018 0.00010
Reproduction (0.0003)	typ: max:	0.00088 0.051	0.0034 0.23	0.000055 0.018	0.00059 0.033

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-2).

Organosulfites

Potential risks from the organosulfite propargite to the survival and reproductive endpoints evaluated are expected to be extremely low. No information on migratory endpoints are currently available. The estimated effects ratios are summarized in Table D-13. Propargite is proposed for infrequent use at Horning, with one application to individual trees between April and October, if needed at all. There is a very low risk to aquatic species under these conditions.

Table D-13. Risks of Organosulfites to Special Status Fish

		Swagger Creek	Nate Creek	Milk Creek	Clear Creek
		Highest Estimated Surface Water Concentration (mg/L)[b]			
	typ: max:	*0.000000052* *0.000000166*	*0.000000281* *0.0000010*	*0* *0*	*0.0000000349* *0.000000115*
Assessment Endpoint (LOEC - mg/L[c])		**Concentration-Effect Ratio[a]**			
Survival (0.008)	typ: max:	0.0000065 0.000021	0.000035 0.00013	0 0	0.0000044 0.000014
Migration (NA[d])	typ: max:	NA	NA	NA	NA
Reproduction (0.028)	typ: max:	0.0000019 0.0000059	0.000010 0.000036	0 0	0.0000012 0.0000041

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-4).
[d]NA = No data available.

Pyrethroids

For typical applications of the insecticides esfenvalerate and permethrin, potential risks to the survival, migratory, and reproductive endpoints evaluated are low in all streams.

For maximum scenario applications of pyrethroid insecticides, potential risks to the survival, migratory, and reproductive endpoints in all off-site streams are low, except for Nate Creek, where risk to reproduction is moderate. Table D-14 summarizes these risk estimates.

These risk estimates may be influenced by environmental factors, as discussed in Section D.2.1, such as turbidity and temperature. Pyrethroid residues in surface runoff will likely be associated with the organic matter, reducing bioavailability of the pesticide. Since warmer temperatures tend to reduce the toxicity of pyrethroids to salmonids, it is unlikely that toxic effects will exceed those described in the literature.

The ammocoetes of lamprey may spend up to five to seven years living and feeding in fine silt and sand on stream bottoms and so may be exposed to toxics for longer periods of time than juvenile salmonids. Also, lamprey ammocoetes may be more susceptible to uptake of chemicals that bind to sediments such as the pyrethroids.

D.3.2 Herbicides

Risks to special status aquatic species from typical and maximum applications of dicamba, glyphosate, hexazinone, picloram and triclopyr are expected to be extremely low. The concentration-effects ratios are presented in Table D-15.

The influence of environmental factors on potential risks to aquatic species appears to be negligible, as discussed in Section D.2. Increasing temperature, pH, hardness, or differences in multiple life stages of salmonids was shown to increase toxicity values up to two- to six-fold by Folmar et al. (1979) and Woodward (1976). Such increases are still not likely to result in any significant toxicity to the fish in Horning's streams or downstream water bodies.

Table D-14. Risks of Pyrethroids to Special Status Fish

		Swagger Creek	Nate Creek	Milk Creek	Clear Creek
		Highest Estimated Surface Water Concentration (mg/L)[b]			
	typ: max:	*0.0000000506* *0.000000123*	*0.000000175* *0.00000049*	*0.0000000172* *0.000000162*	*0.000000034* *0.0000000856*
Assessment Endpoint (LOEC - mg/L[c])		**Concentration-Effect Ratio[a]**			
Survival (0.000025)	typ: max:	0.0022 0.0049	0.0070 0.020	0.00068 0.0065	0.0014 0.0034
Migration (0.0001)	typ: max:	0.000051 0.00012	0.00018 0.00049	0.000017 0.00016	0.000034 0.000086
Reproduction (0.000004)	typ: max:	0.013 0.031	0.044 0.12	0.0043 0.041	0.0085 0.021

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-5).

Table D-15. Risks of Herbicides to Special Status Fish

		Swagger Creek	Nate Creek	Milk Creek	Clear Creek
		Highest Estimated Surface Water Concentration (mg/L)[b]			
	typ:	*0.0000000631*	*0.000000341*	*0*	*0.0000000424*
	max:	*0.000000198*	*0.0000010*	*0*	*0.000000128*
Assessment Endpoint (LOEC - mg/L[c])		**Concentration-Effect Ratio[a]**			
Survival (0.035)	typ:	0.0000018	0.0000090	0	0.0000012
	max:	0.0000057	0.000029	0	0.0000037
Migration (0.046)	typ:	0.0000014	0.0000068	0	0.00000092
	max:	0.0000043	0.000022	0	0.0000028
Reproduction (2.0)	typ:	0.000000032	0.00000016	0	0.000000021
	max:	0.00000010	0.00000050	0	0.000000060

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-7).

D.3.3 Fungicides and Fumigants

Typical and maximum applications of chlorothalonil, dazomet, mancozeb, propiconazole, and thiophanate-methyl are expected to be of extremely low risk to the survival and reproductive endpoints evaluated. No information on migratory endpoints is currently available. The concentration-effects ratios are summarized in Table D-16.

Table D-16. Risks of Fungicides and Fumigants to Special Status Fish

		Swagger Creek	Nate Creek	Milk Creek	Clear Creek
		Highest Estimated Surface Water Concentration (mg/L)[b]			
	typ:	*0.00000000545*	*0.000000030*	*0*	*0.00000000368*
	max:	*0.000000839*	*0.00000405*	*0*	*0.000000542*
Assessment Endpoint (LOEC - mg/L[c])		**Concentration-Effect Ratio[a]**			
Survival (0.0049)	typ:	0.0000011	0.0000061	0	0.00000075
	max:	0.00017	0.00083	0	0.00011
Migration (NA[d])	typ: max:	NA	NA	NA	NA
Reproduction (0.0065)	typ:	0.00000084	0.0000046	0	0.00000057
	max:	0.00013	0.00062	0	0.000083

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-9).
[d]NA = No data available.

D.3.4 Other Pesticides

Extremely low risks to survival endpoints for special status aquatic species are also predicted for hydrogen dioxide and horticultural oil. No information on migratory or reproductive endpoints is currently available. The concentration-effect ratios are presented in Table D-17.

D.3.5 "Other" Ingredients

Potential risks from "other" ("inert") ingredients in the pesticide formulations for special status species in all surface waters are expected to be extremely low for both typical and maximum applications. These compounds include cyclohexanone, ethylbenzene, naphtha, and xylene. The concentration-effect ratios are summarized in Table D-18. Because these compounds volatilize quickly from water and soil to the atmosphere, actual risks to fish are expected to be lower than the above predictions.

D.3.6 Fertilizers

Potential risks to the survival endpoints evaluated from nitrate, phosphate, and calcium nitrate during typical and maximum applications are expected to be extremely low in all surface waters. The risk of ammonium toxicity to fish is low during typical application, but with maximum application the risk is moderate in Swagger Creek, Milk Creek and Clear Creek, and high in Nate Creek. Concentration-effects ratios are presented in Table D-19. No information on migratory or reproductive endpoints is currently available.

Table D-17. Risks of Other Pesticides to Special Status Fish

		Swagger Creek	Nate Creek	Milk Creek	Clear Creek
		Highest Estimated Surface Water Concentration (mg/L)[b]			
	typ: max:	*0.0000000856* *0.000010*	*0.000000475* *0.0000483*	*0.0000000172* *0.000000162*	*0.000000034* *0.0000000856*
Assessment Endpoint (LOEC - mg/L[c])		**Concentration-Effect Ratio[a]**			
Survival (100)	typ: max:	0.0000000009 0.0000001	0.000000005 0.0000005	0.0000000002 0.000000002	0.0000000003 0.0000000009
Migration (NA[d])	typ: max:	N/A	N/A	N/A	N/A
Reproduction (NA[d])	typ: max:	N/A	N/A	N/A	N/A

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see section D.2.4).
[d]NA = No data available.

Table D-18. Risks of "Other" Ingredients to Special Status Fish

		Swagger Creek	Nate Creek	Milk Creek	Clear Creek
		Highest Estimated Surface Water Concentration (mg/L)[b]			
	typ:	*0.0000000557*	*0.000000284*	*0.000000022*	*0*
	max:	*0.00000412*	*0.0000199*	*0.00000154*	*0.00000266*
Assessment Endpoint (LOEC - mg/L[c])		**Concentration-Effect Ratio[a]**			
Survival (0.32)	typ:	0.00000017	0.00000089	0.000000069	0
	max:	0.000013	0.000062	0.0000048	0.0000083
Migration (0.1)	typ:	0.00000056	0.0000028	0.00000022	0
	max:	0.000041	0.00020	0.000015	0.000027
Reproduction (8.0)	typ:	0.0000000070	0.000000036	0.0000000028	0
	max:	0.00000052	0.0000025	0.00000019	0.00000033

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-10).

Table D-19. Risks of Fertilizers to Special Status Fish

		Swagger Creek	Nate Creek	Milk Creek	Clear Creek
		Highest Estimated Surface Water Concentration (mg/L)[b]			
Ammonium	typ:	*0*	*0*	*0*	*0*
	max:	*0.00456*	*0.0124*	*0.00425*	*0.00295*
Nitrate	typ:	*0.000883*	*0.00279*	*0.000957*	*0.000596*
	max:	*0.00136*	*0.00466*	*0.0016*	*0.000942*
Phosphate	typ:	*0.00000239*	*0.00000754*	*0.00000259*	*0.00000161*
	max:	*0.000952*	*0.00314*	*0.00108*	*0.000654*
Calcium nitrate	typ:	*0.000676*	*0.00254*	*0.000372*	*0.000456*
	max:	*0.00123*	*0.00410*	*0.00099*	*0.000853*
Survival Endpoint (LOEC - mg/L[c])		**Concentration-Effect Ratio[a]**			
Ammonium (0.0074)	typ:	0	0	0	0
	max:	0.62	1.6	0.57	0.40
Nitrate (2.0)	typ:	0.00044	0.0014	0.00048	0.00030
	max:	0.00068	0.0023	0.00080	0.00047
Phosphate (49)	typ:	0.000000049	0.00000015	0.000000053	0.000000033
	max:	0.000019	0.000064	0.000022	0.000013
Calcium nitrate (480)	typ:	0.0000014	0.0000053	0.00000078	0.00000095
	max:	0.0000026	0.0000085	0.0000021	0.0000018

[a]The concentration-effect ratio is defined as the estimated chemical concentration over the sublethal effect level.
[b]See Appendix C.
[c]Lowest-observed effect concentration (LOEC) is the sublethal effect level from the laboratory study that reported the greatest sensitivity to the respective assessment endpoint (see Table D-11).

D.4 References

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Appendix E: Public Comments on Draft EIS and BLM Responses

Introduction—NEPA Public Involvement

The Council on Environmental Quality's regulations for implementing the *National Environmental Policy Act* (NEPA) (40 CFR 1500-1508) mandate public participation in the environmental impact analysis process. BLM prepared the Draft EIS and made it available for public review and comment on June 27, 2003. The availability of the Draft EIS was announced as follows:

- A Notice of Availability was published in the *Federal Register* on June 13, 2003.
- Notices were placed in three local newspapers: *Molalla Pioneer* (June 11, 2003); *Clackamas County News* (June 11, 2003); and *Oregonian – Clackamas County edition* (June 12, 2003).
- Copies of the Draft EIS were sent to all 13 city and county public libraries in Clackamas County.
- Postcards offering to send a hard copy or CD of the Draft EIS upon request were sent to the 29 agencies and 146 members of the public on the Draft EIS mailing list.
- Electronic copies of the Draft EIS were placed on the Salem District website for viewing or downloading, at http://www.or.blm.gov/salem/html/planning/horning_ipm.htm
- Copies of the Draft EIS were available in hard copy and CD at the BLM Salem District Office and the Horning Seed Orchard office.

The public comment period ended on August 25, 2003.

BLM held meetings in an open house format to present the findings of the Draft EIS and invite public comments. The meetings were held at Horning Seed Orchard on July 17, 2003 from 1:00 to 3:00 p.m. and 5:00 to 7:00 p.m. There were seven attendees, all BLM employees, at the early session, and no attendees during the late session.

Content Analysis

BLM received very few comments on the Draft EIS. No verbal comments were received during the public meetings and three written comments were received during the public comment period. However, due to the small number of comments received, no statistical analysis of the commentors' demographics and nature of comments was performed.

The meeting attendees at the first session were BLM employees from the seed orchard and the Salem District office; they had no comments. Written comments were received from two Federal agencies and an individual representing herself and two organizations. Table E-1 lists the commentors and the overall focus of their comments. Of the three written comments, two were sent to BLM after the comment deadline of August 25, 2003, but have been considered in preparing the Final EIS.

Of the three commentors, one supported the selection of Alternative B (IPM with Environmental Protection Emphasis—the proposed action and preferred alternative), and

Table E-1. Comment Summary

Tracking Number	Commentor	Format and Date	Focus
H1	Michael P. Tehan National Marine Fisheries Service (NOAA Fisheries) National Oceanic and Atmospheric Administration Portland, OR	Letter dated 8/13/03, received 8/20/03	Suggestions for additional analysis, monitoring, and protection measures for anadromous fish species
H2	Judith Leckrone Lee Manager, Geographic Unit Region 10, U.S. Environmental Protection Agency Seattle, WA	Faxed letter dated 9/10/03, received 9/10/03	Support for Alternative B, pesticide safety, IPM for specific diseases, additional technologies, Port-Orford-Cedar management, pesticides listed in a recent Western District Court decision
H3	Jan Wroncy Individually and representing Coast Range Guardians and Canaries Who Sing Eugene, OR	Letter dated 8/25/03, faxed 8/27/03	Support for Alternative D, opposition to use of pesticides, request to exclude *B.t.* from Alternative D, statement that impacts from pesticides are underestimated and would affect salmon, recommended no use of fertilizers to decrease need for pesticides

one recommended that Alternative D (Non-Chemical Pest Management[1]) be selected. One commentor did not express any preference for a selected alternative, and limited comments to suggestions for changes to the details of Alternative B to further protect threatened salmonid species.

Comments and Responses

Copies of each comment on the Draft EIS are provided at the end of this appendix. Each item (transcript or comment letter) was assigned an identification number (H1 through H3) that appears in the upper right-hand corner of the first page of the comment letter. Because some commentors made more than one comment, each comment was also assigned an identification number. Separate comments within the transcript or letter are numbered along the left margin of the item, and are identified using an alphanumerical code consisting of the item's identification number and the individual comment number. For example, the first separate comment in item H1 is labeled H1-1, the second separate comment is H1-2, and so on. The letters from Federal agencies are presented first, followed by other comments.

Table E-2 presents BLM's responses to each comment, including references to sections of the EIS that were changed, as appropriate. Excerpts from each numbered comment were copied verbatim from the comment letter and presented in Table E-2 to maintain proper context.

[1] Revised to be named Non-Pesticide Pest Management for Final EIS in response to comment H3-2

Table E-2. Comments and Responses.

Comment Number	Comment	Response
Michael P. Tehan, Oregon State Director, Habitat Conservation Division National Marine Fisheries Service (NOAA Fisheries), Oceanic and Atmospheric Administration, Portland, OR		
H1-1	The use of monitoring results related to adaptive management is an important component of the preferred alternative. The draft EIS refers to the importance of integrating monitoring data with future management: "....[adaptive management] would provide a relationship between monitoring results and the management that is planned for the future." (BLM., draft EIS page b-4). NOAA Fisheries agrees that using monitoring data to adjust subsequent applications of compounds [defined as pesticides, herbicides and fertilizers] is vital to a multi-year approach, and presents the following guidance as a proposed structure to achieve this. The EIS should be enhanced by describing the integration of monitoring data that will inform annual application variables as described in the tables of Chapter 2 of the draft EIS. Annual reports should be paired with new proposed application schedules for the upcoming year, which can be modified if necessary by the previous years monitoring results. These yearly reports would facilitate multi-year consultation that accounts for the variability of potential monitoring results, compounds planned for use and application location, methods, and timing. In summary, the annual report should include: (1) Monitoring results that synthesize the relative effectiveness of the application methods and timing to avoid effects to aquatic species; (2) a literature review of any new studies that illuminate effects (from compounds used on the orchards) to aquatic life that are not accounted for in the original EIS; (3) a review of any new best management practices that may further reduce risk to aquatic species; (4) a new annual application schedule that details the type, location, timing, amounts and methods to reduce or avoid effects from compound application, and (5) a new effects analysis, as appropriate, that assesses whether any of the above factors result in effects to aquatic species not analyzed in the EIS and biological opinion (Opinion). If the new annual application plan is within the range of effects analyzed in the Opinion, NOAA Fisheries will indicate in writing that a new section 7(a)(2) or MSA consultation is not necessary, therefore continuing coverage of the Incidental Take Statement of the Opinion for another year. NOAA Fisheries would issue the original Opinion for five years, with annual reports informing whether subsequent Opinions or MSA consultations are necessary for each orchard. These provisions would ensure that the BLM and NOAA Fisheries utilize best available scientific and commercial data to minimize and avoid adverse effects to listed species within the action area.	In the biological assessment (BA) prepared by BLM that formally documents the agency's consultation with NOAA under Section 7 of the *Endangered Species Act*, a procedure for preparing the requested annual reports and submitting them for NOAA review is described. Section 1.4.2 has also been revised to update the description of the consultation process.

Table E-2. Comments and Responses (continued).

Comment Number	Comment	Response
H1-2	The monitoring section only refers to pesticides. Monitoring should be conducted for fertilizers as well.	The monitoring plan described in Appendix B of the EIS has been modified to include fertilizers.
H1-3	The EIS should provide a definition of "high risk ground applications" that will be targeted for applications.	This comment refers to monitoring for drift. The reference to "high risk ground applications" in Appendix B of the EIS has been revised to specify the applications that would be subjects for drift card monitoring. In keeping with the adaptive management approach, drift card monitoring may be adjusted (via the annual reports submitted to NOAA) based on the findings of monitoring activities to date.
H1-4	Monitoring frequency should be described for surface water sampling events from non-aerial application methods.	The description of monitoring in Appendix B of the EIS has been extended to include information on monitoring activities for non-aerial applications.
H1-5	Within validation monitoring, a definition of "significant rainfall events" should be provided.	This sentence in Section B.1.5.3 has been revised to specify that the field runoff collection chamber will be sampled during the first overland flow event following an application. Subsequent sampling of this site will depend on the results from this initial sampling.
H1-6	Fertilizer application should occur at agronomic rates as defined the amount of nutrients applied to vegetation equal the anticipated biological uptake of the plants. This eliminates excess nutrients from polluting surface or ground waters.	Application rates for general fertilization are determined by the results of annual foliar and soil testing, as stated in Section 2.2.2.5 of the EIS. The objective of the general orchard fertilization program is to provide nutrients to only zero deficiency for the crop trees in the orchard. General fertilization and calcium nitrate, which may be applied around specific trees to stimulate their cone production, were not associated with any risks to humans from drinking groundwater or risks to aquatic species in surface water.

Table E-2. Comments and Responses (continued).

Comment Number	Comment	Response
H1-7	Proposed buffer widths for each compound for the orchard unit, as appropriate, should be included in the EIS. Given the vagaries of application conditions and timing, keeping the buffer widths fixed for the term of the consultation is desired by NOAA Fisheries. At the end of the consultation term and subsequent to additional consultation, the opportunity of reduced buffer widths could be discussed. This would take advantage of a larger data set from monitoring, and generally lead to more informed decisions on buffer widths.	In response to this request, a table has been added to Section E.6.4 of the BA that provides the buffer widths for all orchard units adjacent to surface water. If monitoring data available to date at any point in the IPM program lead BLM to determine that reduced buffer widths could be acceptable, a proposal to reduce buffer widths would be offered by BLM via the annual reporting to NOAA (described in Section E.1.5 of the BA). Resolution of the request would be part of the ongoing coordination required by NOAA for multi-year consultation under Section 7 of the ESA.
H1-8	To the greatest extent possible, the potential effects to aquatic life from multiple compound use within the action area should be described.	Section E.8.2 of the BA provides a discussion of the potential for synergistic effects from the proposed pesticides to aquatic species, in response to NOAA's request.
H1-9	NOAA Fisheries prefers that extensive prescribed fire not occur within riparian areas. In cases where the BLM prefers to utilize prescribed fire within riparian areas, the extent should be limited and management methods described that facilitate native vegetation regrowth, and prevention of exposed soils, etc. The EIS should identify these site specific provisions.	Prescribed fire is not proposed for use in any riparian areas at Horning, but is only anticipated for use in the native species beds, limited areas within orchard units, and for pile burning of vegetative/woody debris; see Section 2.2.2.3 of the EIS.
H1-10	To the greatest extent possible, the "Application Frequency" section of table 2.2-1 should be quantitative, rather than terms like "Infrequent".	This table has been revised in response to NOAA's comment.
Judith Leckrone Lee, Manager, Geographic Unit U.S. Environmental Protection Agency, Region 10, Seattle, Washington		
H2-1	U.S. EPA supports the direction and intent of BLM's Preferred Alternative because it emphasizes environmental protection in the management of pests and seed orchards.	Support for Alternative B noted.
H2-2	Based on our review, we have rated the DEIS, EC-2 (Environmental Concerns - Insufficient Information). The rating and a summary of our comments will be published in the *Federal Register*. Our detailed comments and a summary of the rating system we used in our evaluation of this DEIS are enclosed for your reference.	BLM notes EPA's rating. Responses to specific comments are provided below.
H2-3	We recommend that the FEIS discuss additional pesticide safety issues, consider additional IPM methodologies for potentially new orchard diseases, and address the relevancy of a concurrent BLM Draft Supplemental Environmental Impact Statement (Management of Port-Orford-Cedar by Southwest Oregon) which BLM is working on that may impact proposed activities by the four seeds orchards. We also recommend that the FEIS discuss how a recent Western District Court decision may affect the Action Alternatives, especially the Preferred Alternative.	See responses below to detailed EPA comments that are summarized in this paragraph, which appears in EPA's transmittal letter.

Table E-2. Comments and Responses (continued).

Comment Number	Comment	Response
H2-4	<u>List of Proposed Pesticides</u> U.S. EPA recommends that the list of proposed pesticides for use in the seed orchards be wisely considered for potential impacts to worker safety and non-target species. Many of the proposed insecticides identified in the DEIS are older, non-specific pesticides which must be treated with care to minimize damaging non-target organisms and worker safety.	The proposed pesticides are those that have been demonstrated to be effective against potential seed orchard pests and that are labeled for such use under FIFRA by EPA. Additional pesticides that are either not currently available or not currently appropriately labeled may be considered for use by BLM in the future, as discussed in Section 2.4 of the EIS. This discussion also provides details on the procedures to ensure NEPA compliance should BLM propose to implement pest control with newly available chemicals or technologies. BLM prepared a detailed human health and non-target species risk assessments as part of the EIS process. A summary of the risk assessment is provided as Appendix C to the Draft EIS. The full text of the risk assessment is online at the EIS web site at http://www.or.blm.gov/salem/html/planning/horning_ipm.htm, and was included on the Draft EIS CD-ROMs that were sent to all requesting parties on the mailing list. The results of that risk assessment were used to come to the conclusions regarding worker (and public) health impacts from pesticide exposure in Section 4.6 of the Draft EIS, and non-target species impacts in Section 4.7. The pesticide applications that resulted in unacceptable risks to human health or nontarget species were used to develop Alternative B, BLM's proposed action and preferred alternative, as described in Section 2.3.3 of the Draft EIS.
H2-5	Some [proposed pesticides] (e.g. picloram or triclopyr) are know to be highly soluble and under some conditions (rainfall, soil type, amount used) could contaminate groundwater.	The detailed risk assessment (described in response to previous comment) included site-specific modeling of potential groundwater contamination from all proposed pesticides, including picloram and triclopyr. Although some of the pesticides may be mobile in soil, the concentrations predicted by the Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model were far below those that would pose any risk to an individual using the underlying aquifer for all drinking water. See Sections 3 and 6 of the referenced risk assessment for modeling details and risk conclusions, respectively.

Table E-2. Comments and Responses (continued).

Comment Number	Comment	Response
H2-6	Some [proposed pesticides] may be reasonably safe to humans but highly toxic to wildlife. For example, diazinon is highly toxic to some birds, and there is recent research suggesting that they impair salmonid olfaction functions at very low levels.	The detailed risk assessment (described in response to comment H2-4, included risks from diazinon and all other proposed pesticides to wildlife, including several bird species representing a range of habitats and feeding patterns, and salmonids at or near the seed orchard. In addition, a sublethal effects analysis was conducted for special status salmonid species, and was provided as Appendix D to the Draft EIS. Conclusions from these assessments are summarized in Section 4.7 of the EIS, and were considered in developing the limitations that differentiate Alternative A from Alternative B. Table D-2 in Appendix D and the associated text discussion include information on impacts of diazinon exposure on salmonid olfactory fuction.

Table E-2. Comments and Responses (continued).

Comment Number	Comment	Response
H2-7	We recommend that BLM access and run the Natural Resource Conservation Service model, WIN-PEST, for its fields and the planned pesticides as a preliminary analysis of environmental and human risk potential. This modeling program is available to anyone via the web at the NRCS website www.wcc.nrcs.usda.gov/pestmgt/winpst.html. The program needs to have the user input their field soil type(s) (the entire U.S. database is available within this program, the user only needs to know the map unit code or soil series from a soil survey map of their area) and then select the pesticides that will be used on that field. There are a few additional variables to provide including probability of rain following application, pesticide rates (low, med, standard), soil verses foliar applied, broadcast verses banded application as well as others. The model will run a soil type by pesticide interaction and produce a series of human health and aquatic hazard quotients (Extra High risk to Very Low and categories in between) based on the ability of the soilxpesticide to leach to groundwater or runoff via sediment or soil solution. There are many NRCS field offices with staff trained on this program. Also, Oregon State University just received a grant to train technical service providers on using the tool (Paul Jepson and Dan Sullivan at OSU).	As described in the response to comments H2-5 and H2-6, BLM conducted very detailed, site-specific fate and transport modeling of all the proposed pesticides as part of the risk assessment that was part of the EIS process. The parameters identified in EPA's comment are among the dozens of site-specific soil, climate, and pesticide inputs that were used. Please refer to Section 3 of the risk assessment for a detailed description of the GLEAMS model and input parameters. Since very detailed output was required by BLM to identify and manage risks, a detailed risk assessment approach (as opposed to a screening-type model such as WIN-PEST) was selected for use. BLM also notes that the fate and transport component of WIN-PEST relies on averaged results that were developed by USDA using the GLEAMS model. The output from the risk assessment GLEAMS modeling was used to estimate groundwater and surface water concentrations, which were compared to toxicity values identified through a detailed literature review, to estimate risks to both humans and nontarget species from off-site pesticide movement. Please see the referenced risk assessment for extensive detail on the methodology and conclusions. A summary of the risk assessment was also provided as Appendix C to the Draft EIS. The risk assessment conclusions were used to support the risk conclusions presented in Sections 4.6 and 4.7 (human health and nontarget species, respectively) in the Draft EIS.

Table E-2. Comments and Responses (continued).

Comment Number	Comment	Response
H2-8	<u>Root Rot (*Phytophthora*) on Port-Orford-Cedar</u> We recommend that the FEIS explore the potential of using antagonistic fungi, a constituent of finished compost called a fungistat, as a tool for managing and preventing Phytophthora within seed orchard operations. A fungistat is a compound that inhibits fungal growth or sporulation but does not cause death. A fungistat keeps the disease from progressing once it is in the tree, but does not necessarily cure the tree, hence repeated applications are necessary. Research in California has shown some composts enhance biological activity of antagonistic fungi that attack *Verticillium* and *Phytophthora*. Since we did not see a reference in the DEIS to fungistats, we are suggesting that the FEIS investigate and disclose the potential of using fungistats as a means to mitigate any outbreak of *Phytophthora* infections within a seed orchard's stock of Port-Orford-Cedars.	Investigation into this topic and consultation with BLM and Forest Service experts revealed that fungistats may offer some potential for disease control at the seed orchard, although their initial use would be experimental, since no field data on efficacy in seed orchards are available. Should the need arise and the technology appear possibly appropriate at the time, BLM may consider a field trial at the seed orchard. In this case, the procedures listed in Section 2.4 of the EIS would be followed, as they would be in all other cases in which a promising new technology becomes available.
H2-9	<u>Sudden Oak Death (*Phytophthora ramorum*)</u> Sudden Oak Death (SOD) is damaging pathogenic fungus-like algae that invades the bark killing the entire tree or portions of the tree. SOD is spreading across west coast states and its known host species is also expanding. This pathogen, first detected in California in 1995, has advanced northward into southwestern Oregon. According to announcements in early 2001 from Oregon Department of Agriculture and Forestry, the U.S. Forest Service, and BLM, SOD had invaded southwestern Oregon. In addition, SOD can infect many different genuses and species. In 2002, University of California researchers confirmed that coastal redwoods (*Sequoia sempervirens*) and Douglas fir (*Pseudotsuga menziesii* var. menziesii) are host species for the SOD pathogen. The confirmed host species list includes 20 broadleaf species involving 12 different families. A tentative host list is even considerably longer. The potential impact of this pathogen on the seed orchards' tree stocks should not be overlooked. On most non-oak hosts, SOD primarily attacks foliage or stems resulting in non-lethal damage to plants, and it could impact seed production. On Douglas firs for example, the pathogenic infestation causes cankers on small branches, wilting of new shoots, and some dieback of branches and needles (University of California). Furthermore, with the understanding that oak stands are known to exist outside some of the seed orchard areas, the FEISs should address the potential transfer of this pathogen from outside sources into the seed orchards.	In response to this comment, a discussion of sudden oak death and BLM's compliance with current local, state, and Federal quarantine/other regulations has been added to Section 1.4.2 of the Final EIS. At the time the Final EIS went into publication, SOD was confined to two locations in Oregon, neither of which is near the seed orchard. BLM will monitor information bulletins from the Oregon Department of Agriculture and follow all relevant recommendations. Since the locations and containment of this disease, and recommendations for addressing it, are likely to continue to change over the life of the seed orchard IPM program, BLM has not committed to a specific course of action in the event that any seed orchard trees are threatened by SOD. If the planned response does not fall within the alternative selected by the ROD for this EIS, the procedures in Section 2.4 will be followed to ensure NEPA compliance for any proposed activities.

Table E-2. Comments and Responses (continued).

Comment Number	Comment	Response
H2-10	<u>*Phytophthora ramorum and lateralis*</u> The FEIS should disclose how BLM will address the potential for spread of the pathogens *P. ramorum and P. lateralis* through the movement of seedlings, or by infested plant parts such as firewood, wood chips, mulch, leaves, or soil. Oregon Department of Agriculture has reported that researchers have found that *P. ramorum* moves with wood, leaves, surface waters (i.e., streams) and soil. The role of insects and birds in spread of *P. ramorum* disease is also under investigation. The California Department of Agriculture quarantine regulates the movement of bark, bark chips, and mulch. Since the DEIS proposes to dispose of wood from trees by selling it as firewood, be advised that firewood is another potential source of the spread of *P. spp.*, particularly *P. lateralis*. In addition, tractors, to a lesser extent, have considerable potential for moving the spoils within soil from one area to another. These pathogens can also be spread through watershed via streams from spores in water since the spores can readily adhere to eroded soil particles. Finally, we are aware that some organizations have established protection zones along hilltops to prevent the spread of *P. lateralis* downstream in the watershed.	In response to this comment, BLM has added information on measures in place that ensure diseased seedlings are not transported from the greenhouse to offsite locations. Section 2.1.2 has been clarified to state that only routinely pruned wood from healthy trees would be considered for sale as firewood. BLM did not intend to imply that wood from diseased trees would be disposed of in this manner. As stated in response to the previous comment, information has been added to Section B.2 of Appendix B specifically addressing BLM's monitoring activities for sudden oak death.

Table E-2. Comments and Responses (continued).

Comment Number	Comment	Response
H2-11	We suggest that the FEIS consider using parasitoids as another viable biological control methodology of unwanted orchard pests. Insect parasitoids have an immature life stage that develops on or within an insect host, ultimately killing the host species (Biological Control: A Guide to Natural Enemies, Cornell University). Parasitoids can be the dominant and most effective natural enemy of some pest insects, but their presence may not be obvious because parasitoid adults are small and often overlooked. The parasitoid larva inside a cone or seed may look similar to other pest species and could be incorrectly identified as a pest. Under traditional cultural methods, a seed orchard often will have limited sources of available pollen (for egg production) and nectar (for food energy). In these circumstances, parasitoid activity may be naturally low, but could be enhanced with the addition of plants that would provide low-growing flowers for easy parasitoid access. It may be possible to find suitable flowers that would provide nectar and pollen sources without creating additional problems such as increasing fire danger. It may also be possible to monitor parasitoid activity when a subsample of cones are dissected and checked for the presence of seed infesting insects prior to harvest.	While parasitoids are certainly highly likely to contribute to control of seed and cone pest insects in western Oregon seed orchards, the exact nature and degree of control they provide is so poorly understood that research would be required before nectar and pollen sources in BLM seed orchards were increased as a method of controlling seed and cone pests. No research identified by BLM supports either of the commentor's implied statements that (a) parasitoid activity is capable of providing a significant level of control in seed orchard situations, or that (b) a paucity of pollen and nectar sources currently limits parasitoid activity in these seed orchards. The seed orchards contain significant inclusions of natural vegetation and are bordered by unsprayed fence rows and areas of natural forest. In a study conducted by a Forest Service entomologist in the region, many individuals were recovered of wasp species that likely are parasitoids from Douglas fir cone rearings, evidence of an active parasitoid presence in the current seed and cone insect populations in western Oregon. Although it is conceivable that there would there have been more parasitism if there were flowers planted throughout the seed orchards, many basic questions need to be answered before effective management actions could be designed, namely: What parasitoid species prey upon the major seed and cone insect pests in the region? What species of plants do they feed and nectar upon? At what distance from nectar and pollen sources do these particular parasitoids become limited and lose their effectiveness? What is the current level of parasitoid populations in Pacific northwest seed orchards? Is the existing distribution or abundance of pollen and nectar supplies limiting populations of parasitoids in PNW seed orchards? Given these uncertainties, it is the seed orchard's current position that planting flowers throughout the orchard specifically for the purpose of controlling seed and cone insects could not offer a viable management strategy without first conducting scientific studies to provide a factual basis for such action. As for monitoring parasitoids by visual observation during cone dissection, this would be difficult and largely inaccurate. While some parasitoids develop on the bodies of their hosts, others develop inside their hosts and don't emerge until the host has died. Accurate assessment of parasitoid levels would require rearing of seed and cone pest larvae.

Table E-2. Comments and Responses (continued).

Comment Number	Comment	Response
H2-12	We suggest that the FEIS explore the practice of attract-and-kill technology as exemplified by pheromone traps within seed orchards. Pheromone traps utilize chemical attractants which can be used to monitor the presence of certain pest species. While we understand that numbers of individuals captured are not directly related to damage levels in a field, traps can be monitoring tools to detect the presence of specific pests thereby alerting the manager so that appropriate action(s) can be more precisely timed. While the technology is still incomplete, there is some value in using pheromone traps as additional tools in the proposed IPM program.	Pheromone traps are included in the proposed action and all alternatives under the category "Other Control Methods." See Sections 2.2.2.5 and 2.3 of the EIS.
H2-13	<u>Regarding the 54 Pesticides Cited in Washington Toxics Coalition, et al. vs. U.S. EPA</u> BLM should be aware of recent a Western District Court decision (Washington Toxics Coalition, et al. vs U.S. EPA; Western Dist. of Washington at Seattle, Civ. No. C01-132C) which may result in use restrictions of 54 pesticides on federally-listed endangered and threatened salmonids. The court case identified 54 difference pesticides (herbicides, insecticides, and fungicides) of concern. The FEIS should evaluate how this Court decision may affect the Preferred Alternative, including pesticide use near salmonid-bearing waters within the project areas.	The Draft EIS included a discussion of the referenced decision in Section 1.4.2 The consultation between BLM and NOAA, culminating in the issuance of NOAA's Biological Opinion for the action proposed in this Final EIS (see Appendix F), has resolved this issue as it relates to BLM's integrated pest management program at Horning Seed Orchard.
H2-14	<u>Agency Management and Preservation of Port-Orford-Cedar</u> We recommend that the FEIS disclose how BLM will manage and preserve the Port-Orford-Cedar both at the seed orchard scale and across the landscape with which this unique species lives. BLM is involved in two separate yet connected NEPA processes: these three EISs and another concurrent NEPA process for the management of Port-Orford-Cedar in southwestern Oregon (*Draft Supplemental Environmental Impact Statement, Management of Port-Orford-Cedar in Southwest Oregon*). Port-Orford-Cedar is an important tree species of south western Oregon and northern California both for its lumber quality and its functions within regional forest dynamics and processes. Unfortunately, root rot disease (*Phytophthora*) referenced above has caused and is continuing to cause concern for the management and preservation of this tree species. For continuity of agency management and preservation activities, we strongly recommend that the FEIS for the four seed orchards should disclose their contributing part to protect this valued tree species.	Management and preservation of Port-Orford-cedar at locations other than at the seed orchard is outside the scope of this EIS, which is limited to seed orchard pest management. No Port-Orford-cedar trees are present at the seed orchard. BLM will follow all recommendations contained in the ROD for the Port-Orford-cedar management EIS.

Table E-2. Comments and Responses (continued).

Comment Number	Comment	Response
H2-15	<u>Improved Cartographic Information</u> We recommend that all the FEISs improve their cartographic information on illustrating the extent and location of both perennial and ephemeral waterbodies (streams, rivers, wetlands, ponds) and cartographically present the permanence or seasonality of these systems so that appropriate prescriptions and land management allocations are more easily understood by land managers, project reviewers and the general public. We recommend a consistent format of cartographic information among the EISs on water resource information. As a suggestion, Figure 3.4-1 on page 3-7 in the IPM, Travis Tyrrell Seed Orchard DEIS provides the best presentation of the extent and location of perennial and ephemeral streams in the project area. Also, Figure 3.4-1, in the IPM, Water H. Horning Seed Orchard, provides adequate presentation of the extent and location of wetlands within the project area.	Figure 3.4-1 has been revised in response to this comment.

Table E-2. Comments and Responses (continued).

Comment Number	Comment	Response
Jan Wroncy, individually and representing Coast Range Guardians and Canaries Who Sing		
H3-1	On my own behalf and on behalf of the Coast Range Guardians and Canaries Who Sing, I urge you to adopt Alternative D - Non-Chemical Pest Management for the Tyrrell Seed Orchard; Alternative D - Non-Chemical Pest Management for the Horning Seed Orchard; and Alternative C - Non-Chemical Pest Management for the Provolt and Sprague Seed Orchards. *--and--* Therefore, the BLM should adopt the Non-Chemical Pest Management Alternative....	Support for Alternative D is noted. In the Final EIS, Alternative B remains BLM's proposed action and preferred alternative. However, the commentor's request will be considered in selecting the alternative to be implemented by BLM, which will be documented in the Record of Decision. Should BLM select Alternative B, non-chemical methods of pest control would continue to be available. The IPM approach for any specific pest problem incorporates the best-suited method that has minimum impact on the environment and on people, as described in Section 2.2.1.
H3-2	However, the Non-Chemical Pest Management should also include in the prohibited list, the biological control method of using a <u>bioinsecticides</u>, such as Bacillus *thuringiensis* – also known as Bt (formulated as Dipel, Foray 48B, Deliver). Bt formulas are PESTICIDES and do contain CHEMICALS (other ingredients, not necessarily biologically or chemically inert). Dipel, Foray 48B, and Deliver are regulated by the Federal Pesticide law and as such should be included in the Non-Chemical Pest Management list. *--and--* The Bureau of Land Management is ignoring the fact that Deliver, Dipel, Foray 48B (all trade names of pesticide formulas) formulations of Bacillus thuringiensis (Bt) are in fact PESTICIDES, and are, as such, regulated by the Environmental Protection Agency (EPA) as pesticides under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), and under State Pesticide Laws. Also formulas of Bt also contain chemicals serving various purposes in the formula. Thus Bt pesticides are both biological pesticides and chemical pesticides. Therefore Bt and other biopesticides should be included in the list of prohibited substances under the Non-Chemical Alternative. *--and--* Therefore, the BLM should ... add to the list of prohibited substances, the biopesticides such as Bacillus <u>*thuringiensis*</u> pesticide formulas.	In the Draft EIS, BLM included the biological insecticide *B.t.* with all of the other biological control methods that would be available for use under Alternative D. However, in response to this comment, BLM has added *B.t.* to the list of pest control methods that would be excluded under Alternative D. To accurately describe its revised content, Alternative D has been renamed Non-Pesticide Pest Management (instead of Non-Chemical Pest Management) in the Final EIS.

Table E-2. Comments and Responses (continued).

Comment Number	Comment	Response
H3-3	Additionally, Bacillus <u>thuringiensis</u> itself has been shown to have human health impacts as well as environmental impacts. *--and--* Additionally Bt and other biological agents do have both human health concerns and environmental impacts which must be thoroughly analyzed, and fully revealed. See appeal of Forest Service aerially spraying of Bacillus Thuringiensis in the Alsea Watershed this Spring, attached herein as Attachment F.	No scientific data were provided to support the commentor's assertions. However, in response to this comment, BLM has included additional details in the Final EIS in Sections 4.6 and 4.7 on the evaluation of the potential for *B.t.* to cause human health and nontarget species effects as a result of the proposed action or alternatives. The expanded discussions, further documenting BLM's thorough review of the potential human health and ecological effects of *B.t.*, conclude that no significant impacts are expected. The referenced attachment was not included with the commentor's submission.
H3-4	I appealed the decision to aerially spray esfenvalerate (ASANA) by the BLM at the Tyrrell Seed Orchard but have not received notification of a decision from the Interior Board of Land Appeals (IBLA) yet. The decision by the IBLA may impact the final Environmental Impact Statements for the Tyrrell, Provolt, Sprague, and Horning Seed Orchards. I have attached the comments, protest, and some of the appeal documents I submitted on the Tyrrell Seed Orchard aerial spraying of Esfenvalerate (ASANA) in April of 2003. See Attachment A – Comments; Attachment B – Protest; Attachment C – Appeal Statement of Reasons; Attachment D – Objections to Mootness; Attachment E – Answer to BLM's Motion to Dismiss.	The referenced attachments were not included with the commentor's submission. Notwithstanding this omission, the spray project to which these documents apply was completed at Tyrrell Seed Orchard in 2003. Should any future decision be rendered by the IBLA in regard to that case, it will be considered for relevance to the Horning Seed Orchard's proposed IPM program, and BLM will respond appropriately.
H3-5	The issues of compliance with the National Environmental Policy Act (NEPA), the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), the Clean Water Act (CWA), the Endangered Species Act (ESA) and other applicable laws apply also to the present Draft Environmental Impact Statements for the Tyrrell, Provolt, Sprague and Horning Seed Orchards.	BLM is required to comply with all of the cited laws and their implementing regulations, and to coordinate as needed with the responsible agencies to address specific resources. BLM's proposed IPM program meets these requirements, as will any specific activities conducted under the selected alternative.

Table E-2. Comments and Responses (continued).

Comment Number	Comment	Response
H3-6	The listed chemicals proposed for use have far more serious health and environmental effects than indicated by the Risk Assessments. Included in these comments are the following articles available from the Northwest Coalition for Alternatives to Pesticides (NCAP) located on NCAP's website: http://www.pesticide.org. *At this point, the commentor included a list of 17 pesticide fact sheets available from the NCAP website.*	BLM conducted a thorough review of the toxicity, environmental fate, and ecological effects of the proposed pesticides, using agency-accepted or peer-reviewed literature. Every health toxicity endpoint used in the quantitative risk assessment reflects a scientific consensus from EPA or, in the absence of such, criteria from the World Health Organization or Food and Agriculture Organization of the United Nations. All ecotoxicity endpoints reflect the greatest level of toxicity to the most sensitive relevant species from agency-accepted or peer-reviewed literature. In reviewing the fact sheets referenced in this comment, BLM found that many of the citations that appear in the referenced NCAP fact sheets are included in BLM's risk assessment as well. Although the referenced fact sheets summarize effects observed in a laboratory and field tests from a wide range of sources for each pesticide, in many cases the summaries do not provide the doses or concentrations at which these responses were observed, limiting their usefulness in conducting a quantitative risk assessment, nor do they provide any recommendations on values for use in a risk assessment (such as reference doses). BLM believes that the existing risk assessment reflects accepted data and methodology, and has made no changes. *Note:* The commentor referenced the pesticide "Chromated Copper Arsenate" (CCA) and included a link to an NCAP fact sheet on that chemical. CCA is not, and has never been, proposed for inclusion in the IPM program at Horning.

Table E-2. Comments and Responses (continued).

Comment Number	Comment	Response
H3-7	Note that "inert" ingredients are NOT INERT. See articles on "inerts" at: http://www.pesticide.org/inertsreport.pdf [and] http://www.pesticide.org/ActiveInertsRpt.pdf. Additionally, there has been favorable rulings regarding the issue of finding out what other ingredients are in pesticide formulas. See article about court ruling in NCAP v. EPA at http://www.pesticide.org/inertsApr03.html, and the court order at http://www.pesticide.org/inertopinion.pdf.	As stated in Section 4.6.12 of the EIS, the ingredients in a pesticide formulation other than the active ingredient are officially referred to as "other ingredients." The term "inert ingredients" is included as a parenthetical reference only for ease in locating this information for readers who may be more familiar with the historically used terminology. Federal law (FIFRA) has officially described these other ingredients using the term "inert ingredients" since 1947. However, EPA issued a policy statement in 1997 encouraging the voluntary use of the term "other ingredients", so as not to imply that these ingredients were non-toxic. See http://www.epa.gov/opprd001/inerts/ As part of the risk assessment process for this EIS, each pesticide manufacturer was contacted, and voluntarily disclosed whether any other ingredients in the proposed pesticide formulations appeared on EPA's List 1 or 2 (see Appendix C, page C-1 for more information on these lists). Four chemicals on List 2 were identified in one or more formulated products, and these were analyzed in the risk assessment along with the risks from the active ingredients. BLM believes that this approach maintained the appropriate balance between identifying and evaluating potential risks, and respecting legally protected confidential business information. It is important to note that EPA also reviews all components of every formulated pesticide product registered in the U.S., including confidential "other ingredients" that are not disclosed on the product label or the material safety data sheet.
H3-8	The chemical fertilizers that BLM uses in the seed orchard actually cause imbalances and contribute to poor health of the trees. Poor health which in turn actually invites disease, weeds, and other pests. Then pesticides are perceived to be needed to correct this, which in turn further imbalances soil fertility. Maintaining soil fertility naturally by refraining from chemicals would break this vicious cycle.	The basis of this statement is unclear. BLM is not aware of any scientific data that support a direct linkage between the fertilizers used by BLM and poor tree health. In addition, no scientific data were identified by the commentor that support her assertions. Please also refer to the response to comment H1-6 above.

Table E-2. Comments and Responses (continued).

Comment Number	Comment	Response
H3-9	Both the active ingredients and the other ingredients (mislabeled "inerts") have lethal and sublethal effects on salmon and also impact essential fish habitat. See Diminishing Returns: Salmon Decline and Pesticides by Dr. Richard D. Ewing, PhD, February 1999. The text may also be found at http://www.pesticide.org/salpest.pdf Several pesticides and the chemical fertilizers can have devastating impacts on salmon. In the case of Washington Toxics, et al v. EPA there are rulings now calling for buffers along salmon streams when either ground or aerial spraying of these pesticide. See the Fact Sheet about Pesticides, Salmon, and Endangered Species Act herein Appendix G; the News Press Release from Earthjustice July 17, 2003 as Attachment H – the court order signed on July 16, 2003 as Attachment I; and the court order signed August 8, 2003 as Attachment J. The Fact sheet may also be found at: http://www.earthjustice.org/news/documents/7-03/salmon_lawsuit_factsheet.pdf The News Press Release may be found at: http://www.earthjustice.org/news/print.html?ID=635 The July 17th Order may be found at: http://www.pesticide.org/Order7-16-03.pdf The August 8th Order may be found at: http://agr.wa.gov/PestFert/EnvResources/docs/OrderFurtherInjunctiveRelief8-8-03.pdf The Draft EIS does not adequately address the impacts to salmon. Although the BLM chooses not to consider the salmon as an irretrievable resource, once lost, we will never get them back. By choosing chemical management, the BLM is sacrificing an endangered species for sake of saving money for private cooperators.	See reply to comment H3-7 regarding the use of the term "inerts". Section 4.7, Appendix C, and Appendix D of both the Draft and Final EISs contain analyses of the potential lethal and sublethal impacts to salmon. Because no effects are predicted, salmon are not addressed under the subject of "irretrievable commitment of resources." During the EIS process, BLM consulted with NOAA Fisheries under Section 7 of the *Endangered Species Act* regarding potential impacts from the proposed action to steelhead trout and chinook salmon, which are listed as threatened species; and coho salmon, which are proposed for listing as a threatened species. BLM's Biological Assessment and NOAA's Biological Opinion include analysis of the potential for both lethal and sublethal effects, as well as evaluation of the impacts to essential fish habitat. The EIS analysis did not predict any lethal or sublethal impacts to salmon or steelhead from non-accident use of the proposed pesticides. See also response provided to comment H3-12.

Table E-2. Comments and Responses (continued).

Comment Number	Comment	Response
H3-10	As far as I can find out, there was never a NEPA process whereby the public was invited to comment on the impacts of giving use of public property (the orchards of BLM) without compensation for establishment of the orchards (paid for by public funds) to private timber and seed companies to profit by the original expenditure of Federal Funding to establish the public seed orchard for the growing of trees to replant the public lands which were harvested. The BLM does not need to replant large acreages as it once did. Private timber companies can afford to pay more for the seeds for trees to replant the large acreages that it has harvested at great private gain on private lands.	The current mission of the Horning Seed Orchard is outside the scope of this EIS, which is limited to options for pest management at the seed orchard. As stated in Section 1.4.1 of the Draft EIS, the Salem District Resource Management Plan/EIS included the seed orchard within the District Designated Reserve system. Please refer to Section 1.4.1 of the EIS for additional information on the provisions of the district RMP/EIS as they are applicable to Horning.
H3-11	Now the BLM is spending huge sums of money to develop EISs to justify using chemicals on public land rather than funding research into the alternatives to chemical management. With all the health concerns, the environmental concerns and the new endangered species concerns, these funds spent on justifying chemical use instead of research into the alternatives is a waste of public funds.	NEPA compliance is required for major Federal actions that may have an impact on the environment. BLM made a determination that an EIS was the appropriate level of NEPA documentation for the proposed IPM program. The IPM approach for any specific pest problem incorporates the best-suited method that has minimum impact on the environment and on people, as described in Section 2.2.1, and includes both chemical and non-chemical methods of pest control. BLM's immediate pest control needs are described in Chapter 1 of this EIS, and must be met using the methods available at any given time. However, Section 2.4 describes in detail a process for approving new products and technologies for inclusion in the IPM program, in keeping with the IPM principle that an effective and affordable control method with the least impact would be the manager's first choice. BLM looks forward to opportunities to expand the non-chemical pest control methods utilized by following this process, which includes mechanisms for keeping informed of new developments in seed orchard pest management, and assessing effectiveness by activities including field trials of promising technologies.

Table E-2. Comments and Responses (continued).

Comment Number	Comment	Response
H3-12	Damage from contamination of water, air and soil is unjustifiable. Destruction of non-target organisms is unnecessary and inconsistent with goals to maintain ecosystem balance or biodiversity. There is no need or justification for destroying salmon habitat, or for killing salmon to produce seed cheaply. The BLM has spent millions on protection and restoration of salmon habitat in other programs that it conducts (such as the fish ladder on Lake Creek at the Hult Reservoir, and at Triangle Lake), which is defeated by killing salmon and destroying salmon habitat at the Tyrrell, Provolt, Sprague and/or Horning Seed Orchards.	As summarized in Section 2.6 and Table 2.6-1, no significant impacts to air, water, or soil are predicted from implementation of Alternative B. Except for localized temporary impacts to non-target insects, or the unlikely event of an accidental spill, no risks were predicted to non-target organisms from any of the proposed pesticides. The EIS analysis did not predict the death of salmon or destruction of their habitat, nor even any sublethal effects to salmon, from non-accident use of the proposed pesticides. Please see the conclusions presented in Section 4.7 and summarized in Section 2.6 and Table 2.6-1. It should also be noted that the purpose and need for this action is to manage pests at the seed orchard, and not to maintain ecosystem balance or biodiversity, as may have been implied by this comment. While these are important considerations, and are factors in identifying potential impacts of the proposed action, they are not stated as "goals" for the purpose of this NEPA process.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
525 NE Oregon Street
PORTLAND, OREGON 97232-2737

Refer to:
OHB2003-0192-GC

August 13th, 2003

Mr. Greg Tyler, Manager
Horning Seed Orchard
27004 Sheckly Road
Colton, OR 97017

Re: Draft Environmental Impact Statement for the Proposed Integrated Pest Management (IPM) Program at the Bureau of Land Management's (BLM) Horning Seed Orchard

Dear Mr. Tyler:

NOAA's National Marine Fisheries Service (NOAA Fisheries) staff have reviewed the above mentioned draft Environmental Impact Statement (EIS), and present these comments[1] within the context of the National Environmental Policy Act (NEPA) and in anticipation of a section 7(a)(2) consultation under the Endangered Species Act and the Magnuson-Stevens Fishery Conservation and Management Act (MSA). In accordance with NEPA regulations at 40 CFR part 1503.2, "federal agencies with jurisdiction by law or special expertise with respect to any environmental impact involved and agencies which are authorized to develop and enforce environmental standards shall comment on statements within their jurisdiction, expertise, or authority". These comments are on the preferred alternative (Alternative B-IPM with Environmental Protection Emphasis) as described in the draft EIS.

H1-1

The use of monitoring results related to adaptive management is an important component of the preferred alternative. The draft EIS refers to the importance of integrating monitoring data with future management: "....[adaptive management] would provide a relationship between monitoring results and the management that is planned for the future." (BLM., draft EIS page b-4). NOAA Fisheries agrees that using monitoring data to adjust subsequent applications of compounds[2] is vital to a multi-year approach, and presents the following guidance as a proposed structure to achieve this.

The EIS should be enhanced by describing the integration of monitoring data that will inform annual application variables as described in the tables of Chapter 2 of the draft EIS. Annual

[1] As the proposed action is continued to be refined, additional comments will likely be delivered to the BLM within the context of ESA section 7(a)(2) and MSA consultation.

[2] "Compounds" is defined as pesticides, herbicides and fertilizers.

H1-6 Fertilizer Application

Fertilizers application should occur at agronomic rates, as defined the amount of nutrients applied to vegetation equal the anticipated biological uptake of the plants. This eliminates excess nutrients from polluting surface or ground waters.

Buffer Widths

H1-7 Proposed buffer widths for each compound for the orchard unit, as appropriate, should be included in the EIS. Given the vagaries of application conditions and timing, keeping the buffer widths fixed for the term of the consultation is desired by NOAA Fisheries. At the end of the consultation term and subsequent to additional consultation, the opportunity of reduced buffer widths could be discussed. This would take advantage of a larger data set from monitoring, and generally lead to more informed decisions on buffer widths.

H1-8 Synergistic Effects

To the greatest extent possible, the potential effects to aquatic life from multiple compound use within the action area should be described.

Prescribed Fire

H1-9 NOAA Fisheries prefers that extensive prescribed fire not occur within riparian areas. In cases where the BLM prefers to utilize prescribed fire within riparian areas, the extent should be limited and management methods described that facilitate native vegetation regrowth, and prevention of exposed soils, etc. The EIS should identify these site specific provisions.

H1-10 Application Schedules

To the greatest extent possible, the "Application Frequency" section of table 2.2-1 should be quantitative, rather than terms like "Infrequent".

NOAA Fisheries appreciates the BLM's early coordination efforts for the proposed action, and looks forward to continuing discussions as this project progresses. If you have any questions regarding this letter, you may contact Dan Tonnes of my staff in the Oregon Habitat Branch at (503) 736-4743 or Dan.Tonnes@NOAA.gov

Sincerely,

Michael P. Tehan
Oregon State Director
Habitat Conservation Division

cc: Bob Ruediger, BLM
Neil Armantrout, BLM
Jason Sandahl, Labbat-Anderson Inc.

3

H1-6

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Sincerely,

Michael P. Tehan
Oregon State Director
Habitat Conservation Division

cc: Bob Ruediger, BLM
Neil Armantrout, BLM
Jason Sandahl, Labbat-Anderson Inc.

3

REFERENCES

Lee, K. K. 1995. Stream velocity and dispersion characteristics determined by dye tracer studies on selected stream reaches in the Willamette River Basin, Oregon. U.S. Geological Survey Water Resources Investigations Report 95-4078. Available at: http://oregon.usgs.gov/pubs_dir/pdf/95-4078.pdf. 48 p.

Heard, S. B. C. B. Gienapp, J. F. Lemire, and K. S. Heard. 2001. Transverse mixing of transported material in simple and complex stream reaches. Hydrobiologia 464:207-218

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

SEP 10 2003

Reply To Attn Of: ECO-088

Ref: 01-016-BLM, 01-017-BLM, 01-018-BLM, & 01-019-BLM

Mr. Harvey Koester, Manager
Bureau of Land Management
Provolt and Sprague Seed Orchards
3040 Biddle Road
Medford, OR 97504

Mr. Glenn Miller, Manager
Bureau of Land Management
Tyrrell Seed Orchard
P.O. Box 121
Lorane, OR 97451

Mr. Greg Tyler, Manager
Bureau of Land Management
Horning Seed Orchard
27004 Scheckly Road
Colton, OR 97017

Dear BLM Seed Orchard Managers:

The U.S. Environmental Protection Agency (EPA) has reviewed three Draft Environmental Impact Statements (DEIS) for the proposed **Integrated Pest Management Programs, Provolt Seed Orchard** and **Sprague Seed Orchard, Walter H. Horning Seed Orchard, and Travis Tyrrell Seed Orchard** pursuant to our responsibilities under Section 309 of the Clean Air Act and the National Environmental Policy Act (NEPA) as amended. Section 309, independent of NEPA, directs U.S. EPA to review and comment in writing on the environmental impacts associated with all major federal actions.

The Bureau of Land Management (BLM) is proposing to implement a common integrated pest management (IPM) program at four seed orchard operations in the Oregonian towns of Provolt, (Provolt Seed Orchard), Merlin (Sprague Seed Orchard), Colton (Walter H. Horning Seed Orchard), and Loraine (Travis Seed Orchard). All four DEISs propose the same four Action Alternatives:

- Maximum Production IPM (Alternative A)
- IPM with Environmental Protection Emphasis (Alternative B),
- Ground-Based IPM (Alternative C)
- Non-Chemical Pest Management (Alternative D)

For baseline purposes, all of the DEISs have proposed the No Action Alternative (Alternative E) which is the current management approach. Also, all of the DEISs have identified Alternative B as BLM's Proposed Alternative.

H2-1 U.S. EPA supports the direction and intent of BLM's Preferred Alternative because it emphasizes environmental protection int the management of pests and seed orchards.

H2-2 Based on our review, we have rated the DEIS, EC-2 (Environmental Concerns - Insufficient Information). The rating and a summary of our comments will be published in the *Federal Register.* Our detailed comments and a summary of the rating system we used in our evaluation of this DEIS are enclosed for your reference.

H2-3 We recommend that the FEIS discuss additional pesticide safety issues, consider additional IPM methodologies for potentially new orchard diseases, and address the relevancy of a concurrent BLM Draft Supplemental Environmental Impact Statement (Management of Port-Orford-Cedar by Southwest Oregon) which BLM is working on that may impact proposed activities for the four seeds orchards. We also recommend that the FEIS discuss how a recent Western District Court decision may affect the Action Alternatives, especially the Preferred Alternative.

I encourage you to contact Tom Connor at (206) 553-4423 or Sharon Collman, our Pesticides/IPM Outreach Coordinator, at (206) 553-2876 if you would like to discuss our comments. Thank you for the opportunity to review these four Draft EISs on the Integrated Pest Management Program for BLM's Provolt, Sprague, Horning, and Tyrrell Seed Orchards.

Sincerely,

Gary Voerman

Judith Leckrone Lee, Manager
Geographic Unit

Enclosures

2

U.S. Environmental Protection Agency's Detailed Comments on the Integrated Pest Management, Provolt, Charles A. Sprague, Walter H. Horning, and Travis Tyrrell Seed Orchards Environmental Impact Statements

Environmental Issues

List of Proposed Pesticides

H2-4

U.S. EPA recommends that the list of proposed pesticides for use in the seed orchards be wisely considered for potential impacts to worker safety and non-target species. Many of the proposed insecticides identified in the DEIS are older, non-specific pesticides which must be treated with care to minimize damaging non-target organisms and worker safety.

H2-5

Some (e.g. picloram or triclopyr) are known to be highly soluble and under some conditions (rainfall, soil type, amount used) could contaminate groundwater.

H2-6

Some may be reasonably safe to humans but highly toxic to wildlife. For example, diazinon is highly toxic to some birds, and there is recent research suggesting that they impair salmonid olfaction functions at very low levels. .

H2-7

We recommend that BLM access and run the Natural Recource Conservation Service model, WIN-PEST, for its fields and the planned pesticides as a preliminary analysis of environmental and human risk potential. This modeling program is available to anyone via the web at the NRCS website www.wcc.nrcs.usda.gov/pestmgt/winpst.html.

The program needs to have the user input their field soil type(s) (the entire US database is available within this program, the user only needs to know the map unit code or soil series from a soil survey map of their area) and then select the pesticides that will be used on that field. There are a few additional variables to provide including probability of rain following application, pesticide rate (low, med, standard), soil verses foliar applied, broadcast verses banded application as well as others. The model will run a soil type by pesticide interaction and produce a series of human health and aquatic hazard quotients (Extra High risk to Very Low and categories in between) based on the ability of the soilxpesticide to leach to groundwater or runoff via sediment or soil solution.

There are many NRCS field offices with staff trained on this program. Also, Oregon State University just received a grant to train technical service providers on using the tool (Paul Jepson and Dan Sullivan at OSU).

Page 1 of 4

Root Rot *(Phytophthora)* on Port-Orford-Cedar

H2-8

We recommend that the FEIS explore the potential of using antagonistic fungi, a constituent of finished compost called a fungistat, as a tool for managing and preventing Phytophthora within seed orchard operations. A fungistat is a compound that inhibits fungal growth or sporulation but does not cause death. A fungistat keeps the disease from progressing once it is in the tree but does not necessarily cure the tree, hence repeated applications are necessary. Research in California has shown some composts enhance biological activity of antagonistic fungi that attack *Verticillium* and *Phytophthora.* Since we did not see a reference in the DEIS to fungistats, we suggest that the FEIS investigate and disclose the potential of using fungistats as a means to mitigate any outbreak of *Phytophthora* infections within a seed orchard's stock of Port-Orford-Cedars.

Sudden Oak Death *(Phytophthora ramorum)*

H2-9

Sudden Oak Death (SOD) is damaging pathogenic fungus-like algae that invades the bark killing the entire tree or portions of the tree. SOD is spreading across west coast states and its known host species is also expanding. This pathogen, first detected in California in 1995, has advanced northward into southwestern Oregon. According to announcements in early 2001 from Oregon Department of Agriculture and Forestry, the U.S. Forest Service, and BLM, SOD had invaded southwestern Oregon. In addition, SOD can infect many different genuses and species. In 2002, University of California researchers confirmed that coastal redwoods (*Sequoia sempervirens*) and Douglas fir (*Pseudotsuga menziesii* var. menziesii) are host species for the SOD pathogen. The confirmed host species list includes 20 broadleaf species involving 12 different families. A tentative host list is even considerably longer. The potential impact of this pathogen on the seed orchards' tree stocks should not be overlooked. On most non-oak hosts, SOD primarily attacks foliage or stems resulting in non-lethal damage to plants, and it could impact seed production. On Douglas firs for example, the pathogenic infestation causes cankers on small branches, wilting of new shoots, and some dieback of branches and needles (University of California). Furthermore, with the understanding that oak stands are known to exist outside some of the seed orchard areas, the FEISs should address the potential transfer of this pathogen from outside sources into the seed orchards

Phytophthora ramorum and lateralis

H2-10

The FEIS should disclose how BLM will address the potential for spread of the pathogens *P. ramorum and P. lateralis* through the movement of seedlings, or by infested plant parts such as firewood, wood chips, mulch, leaves, or soil. Oregon Department of Agriculture has reported that researchers have found that *P. ramorum* moves with wood, leaves, surface waters (i.e., streams) and soil. The role of insects and birds in spread of *P. ramorum* disease is also under investigation. The California Department of Agriculture quarantine regulates the movement of bark, bark chips, and mulch. Since the DEIS proposes to dispose of wood from trees by selling it as firewood, be advised that firewood is another potential source of the spread of *P. spp.*, particularly *P. lateralis.* In addition, tractors, to a lesser extent, have considerable

Page 2 of 4

H2-10

potential for moving the spores within soil from one area to another. These pathogens can also be spread through a watershed via streams from spores in water since the spores can readily adhere to eroded soil particles. Finally, we are aware that some organizations have established protection zones along hilltops to prevent the spread of *P. lateralis* downstream in the watershed.

Potential Improvements to the Proposed IPM Program

H2-11

(1) Parasitoids. We suggest that the FEIS consider using parasitoids as another viable biological control methodology of unwanted orchard pests. Insect parasitoids have an immature life stage that develops on or within an insect host, ultimately killing the host species (Biological Control: A Guide to Natural Enemies, Cornell University). Parasitoids can be the dominant and most effective natural enemy of some pest insects, but their presence may not be obvious because parasitoid adults are small and often overlooked. The parasitoid larva inside a cone or seed may look similar to other pest species and could be incorrectly identified as a pest.

Under traditional cultural methods, a seed orchard often will have limited sources of available pollen (for egg production) and nectar (for food energy). In these circumstances, parasitoid activity may be naturally low, but could be enhanced with the addition of plants that would provide low-growing flowers for easy parasitoid access. It may be possible to find suitable flowers that would provide nectar and pollen sources without creating additional problems such as increasing fire danger. It may also be possible to monitor parasitoid activity when a subsample of cones are dissected and checked for the presence of seed infesting insects prior to harvest.

H2-12

(2) Pheromone Traps. We suggest that the FEIS explore the practice of attract-and-kill technology as exemplified by pheromone traps within seed orchards. Pheromone traps utilize chemical attractants which can be used to monitor the presence of certain pest species. While we understand that numbers of individuals captured are not directly related to damage levels in a field, traps can be monitoring tools to detect the presence of specific pests thereby alerting the manager so that appropriate action(s) can be more precisely timed. While the technology is still incomplete, there is some value in using pheromone traps as additional tools in the proposed IPM program.

Pesticide Restrictions

H2-13

Regarding the 54 Pesticides Cited in Washington Toxics Coalition, et al. vs U.S. EPA

BLM should be aware of recent a Western District Court decision (Washington Toxics Coalition, et al. vs U.S. EPA; Western Dist. of Washington at Seattle, Civ. No. C01-132C) which may result in use restrictions of 54 pesticides on federally-listed endangered and threatened salmonids. The court case identified 54 different pesticides (herbicides, insecticides, and fungicides) of concern. The FEIS should evaluate how this Court decision may affect the Preferred Alternative, including pesticide use near salmonid-bearing waters within the project areas.

Page 3 of 4

Additional Concern

Agency Management and Preservation of Port-Orford-Cedar

We recommend that the FEIS disclose how BLM will manage and preserve the Port-Orford-Cedar both at the seed orchard scale and across the landscape within which this unique species lives. BLM is involved in two separate yet connected NEPA processes: these three EISs and another concurrent NEPA process for the management of Port-Orford-Cedar in southwestern Oregon (*Draft Supplemental Environmental Impact Statement, Management of Port-Orford-Cedar in Southwest Oregon*).

H2-14

Port-Orford-Cedar is an important tree species of south western Oregon and northern California both for its lumber quality and its functions within regional forest dynamics and processes. Unfortunately, the root rot disease (*Phytophthora*) referenced above has caused and is continuing to cause concern for the management and preservation of this tree species. For continuity of agency management and preservation activities, we strongly recommend that the FEIS for the four seed orchards should disclose their contributing part to protect this valued tree species.

Improved Cartographic Information

We recommend that all the FEISs improve their cartographic information on illustrating the extent and location of both perennial and ephemeral waterbodies (streams, rivers, wetlands, ponds) and cartographically present the permanence or seasonality of these systems so that appropriate prescriptions and land management allocations are more easily understood by land managers, project reviewers and the general public.

H2-15

We recommend a consistent format of cartographic information among the EISs on water resource information. As a suggestion, Figure 3.4-1 on page 3-7 in the IPM, Travis Tyrrell Seed Orchard DEIS provides the best presentation of the extent and location of perennial and ephemeral streams in the project area. Also, Figure 3.4-1, in the IPM, Water H. Horning Seed Orchard, provides adequate presentation of the extent and location of wetlands within the project area.

U.S. Environmental Protection Agency Rating System for Draft Environmental Impact Statements Definitions and Follow-Up Action*

Environmental Impact of the Action

LO – Lack of Objections

The U.S. Environmental Protection Agency (EPA) review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC – Environmental Concerns

EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce these impacts.

EO – Environmental Objections

EPA review has identified significant environmental impacts that should be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no-action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU – Environmentally Unsatisfactory

EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the Council on Environmental Quality (CEQ).

Adequacy of the Impact Statement

Category 1 – Adequate

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis of data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2 – Insufficient Information

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses or discussion should be included in the final EIS.

Category 3 – Inadequate

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the National Environmental Policy Act and or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

* From EPA Manual 1640 Policy and Procedures for the Review of Federal Actions Impacting the Environment. February, 1987.

FAX – Comments Horning EIS

Date August 25, 2003

Number of pages including cover sheet =

To: Greg Tyler, Manager
Salem BLM
Horning Seed Orchard
27004 Sheckly Road
Colton, OR 97017
Phone
Fax Phone (503) 630-6888

From: Jan Wroncy
Post Office Box 1101
Eugene, OR 97440
Phone
Fax Phone 541-925-4130

email: oripmeis@blm.gov

REMARKS: Comments on Draft Environmental Impact Statement - Integrated Pest Management for the Horning Seed Orchard

I need to send these comments a bit later than closing today because the electric company has been trimming and cutting trees in front of our house since 7:30 AM. The noise and the diesel fumes, as well as the potential for power outage if any limbs falling might shut off power have conspired to keep me away from my computer until 2 PM. Blachly Electric could not reschedule this activity, and since the trimming of limbs that were growing into the powerlines and burning the tips was critical, I did not want to hold up this important operation. I have attempted to finalize the comments on time, but I fear that they will not be ready for several hours. I therefore am asking you to accept these even though they might arrive after hours.

Respectfully submitted by,

Jan Wroncy

Jan Wroncy

Glenn Miller, Manager
Travis Tyrrell Seed Orchard
Post Office Box 121
Lorane, Oregon 97451

August 25, 2003

Greg Tyler, Manager
Horning Seed Orchard
27004 Sheckly Road
Colton, OR 97017

Harvey Koester, Manager
Provolt and Sprague Seed Orchards
3040 Biddle Road
Medford, OR 97504

RE: Comments on the Draft Environmental Impact Statements for Integrated Pest Management for the Bureau of Land Management's Tyrrell, Provolt, Sprague, and Horning Seed Orchards, June 2003.

Dear Mr. Miller, Mr. Tyler and Mr. Koester:

H3-1 **On my own behalf and on behalf of the Coast Range Guardians, and Canaries Who Sing, I urge you to adopt Alternative D – Non-Chemical Pest Management for the Tyrrell Seed Orchard; Alternative D – Non-Chemical Pest Management for the Horning Seed Orchard; and Alternative C – Non-Chemical Pest Management for the Provolt and Sprague Seed Orchards.**

The Non-Chemical Pest Management "would allow the seed orchard manager to use only the biological, prescribed fire, cultural, and other non-chemical-pesticide methods listed under Alternative A. No chemical pesticides would be permitted" at page 2-17, section 2.3.4 in the Tyrrell Draft EIS; page 2-19, section 2.3.5 in the Horning Draft EIS; and at page 2-21, section 2.3.4 in the Provolt and Sprague Draft EIS.

H3-2 **However the Non-Chemical Pest Management should also include in the prohibited list, the biological control method of using a bioinsecticides, such as Bacillus *thuringiensis* - also known as Bt (formulated as Dipel, Foray 48B, Deliver). Bt formulas are PESTICIDES and do contain CHEMICALS (other ingredients, not necessarily biologically or chemically inert). Dipel, Foray 48B, and Deliver are regulated by the Federal Pesticide law and as such should be included in the Non-Chemical Pest Management prohibited list.**
H3-3 **Additionally Bacillus thuringiensis itself has been shown to have human health impacts as well as environmental impacts.**

APPEAL DECISION STILL PENDING FROM THE INTERIOR BOARD OF LAND APPEALS

H3-4

I appealed the decision to aerially spray Esfenvalerate (ASANA) by the BLM at the Tyrrell Seed Orchard but have not received notification of a decision from the Interior Board of Land Appeals (IBLA) yet. The decision by the IBLA may impact the final Environmental Impact Statements for the Tyrrell, Provolt, Spague, and Horning Seed Orchards.

I have attached the comments, protest, and some of the appeal documents I submitted on the Tyrrell Seed Orchard aerial spraying of Esfenvalerate (ASANA) in April of 2003. See **Attachment A - Comments; Attachment B - Protest; Attachment C - Appeal Statement of Reasons; Attachment D - Objections to Mootness; Attachment E - Answer to BLM's Motion to Dismiss.**

H3-5

The issues of compliance with the National Environmental Policy Act (NEPA), the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), the Clean Water Act (CWA), the Endangered Species Act (ESA) and other applicable laws apply also to the present Draft Environmental Impact Statements for the Tyrrell, Provolt, Sprague and Horning Seed Orchards.

BLM IS IGNORING IMPACTS OF BACILLUS *THURINGIENSIS* PESTICIDE FORMULAS

H3-2

The Bureau of Land Management is ignoring the fact that Deliver, Dipel, Foray 48B (all trade names of pesticide formulas) formulations of Bacillus thuringiensis (Bt) are in fact PESTICIDES, and are, as such, regulated by the Environmental Protection Agency (EPA) as pesticides under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), and under State Pesticide Laws. Also formulas of Bt also contain chemicals serving various purposes in the formula. Thus Bt pesticides are both biological pesticides and chemical pesticides. Therefore Bt and other biopesticides should be included in the list of prohibited substances under the Non-Chemical Alternative. Additionally Bt and other biological agents do have both human health concerns and environmental impacts which must be thoroughly analyzed, and fully revealed.

H3-3

See appeal of Forest Service aerially spraying of Bacillus Thuringiensis in the Alsea Watershed this Spring, attached herein as **Attachment F.**

IMPACTS OF PESTICIDES UNDERESTIMATED

H3-6

The listed chemicals proposed for use have far more serious health and environmental effects than indicated by the Risk Assessments. Included in these comments are the following articles available from the Northwest Coalition for Alternatives to Pesticides (NCAP) located at NCAP'S website:
http://www.pesticide.org

Acephate

*Bt:
http://www.pesticide.org/bacillus.pdf

*chlorothalonil:
http://www.pesticide.org/chlorothalonil.pdf

*chlorpyrifos:
http://www.pesticide.org/chlorpyrifos1.pdf
http://www.pesticide.org/chlorpyrifos2.pdf
http://www.pesticide.org/chlorpyrifos3.pdf
http://www.pesticide.org/chlorpyrifosNEWS.pdf

*Chromated Copper Arsenate:
http://www.pesticide.org/chromated.pdf
dazomet

(formaldehyde, MITC, Monomethylamine, carbon disulfide)

*diazinon:
http://www.pesticide.org/DiazinonTox.pdf
http://www.pesticide.org/DiazinonEco.pdf
http://www.pesticide.org/diazinonNEWS.pdf

H3-6

*dicamba:
http://www.pesticide.org/dicamba.pdf

dimthoate

*esfenvalterate:
http://www.pesticide.org/toxicology.pdf

*glyphosate:
http://www.pesticide.org/gly.pdf

hexazinone

horticultural oil

*permethrin:
http://www.pesticide.org/Permethrin.pdf
http://www.pesticide.org/toxicology.pdf

Wroncy/Coast Range Guardians/Canaries Who Sing - Comments on Seed Orchard IPM Draft EIS August 25, 2003 Page - 3

*picloram:
http://www.pesticide.org/picloram.pdf

(hexachlorobenzene)

H3-6

propargite
propiconazole

*triclopyr:
http://www.pesticide.org/triclopyr.pdf

**nitrate (note that nitrate is misleading, the chemical fertilizers that BLM uses are not pure nitrate)

***Inert ingredients:
(cyclohexanone, ethylbenene, light aromatic solvent naptha, xylene)

"INERTS" NOT INERT

H3-7

***Note that "inert" ingredients are NOT INERT. See articles on "inerts" at:
http://www.pesticide.org/inertsreport.pdf
http://www.pesticide.org/ActiveInertsRpt.pdf

Additionally there has been favorable rulings regarding the issue of finding out what other ingredients are in pesticide formulas. See article about court ruling in NCAP v. EPA at:
http://www.pesticide.org/InertsApr03.html
and the court order at:
http://www.pesticide.org/inertopinion.pdf

CHEMICAL FERTILIZERS CAUSE IMBALANCES AND POOR HEALTH OF TREES

H3-8

The chemical fertilizers that BLM uses in the seed orchard actually cause soil fertility imbalances and contribute to poor health of the trees. Poor health which in turn actually invites disease, weeds and other pests. Then pesticides are perceived to be needed to correct this, which in turn further imbalances soil fertility. Maintaining soil fertility naturally by refraining from chemicals would break this vicious cycle.

IMPACTS ON SALMON

H3-9

Both the active ingredients and the other ingredients (mislabeled "inerts") have lethal and sublethal effects on salmon and also impact essential fish habitat. See <u>**Diminishing Returns Returns: Salmon Decline and Pesticides**</u> by Dr. Richard D. Ewing, PhD, February 1999.

The text also may be found at:
http://www.pesticide.org/salpest.pdf

Several pesticides and the chemical fertilizers can have devastating impacts on salmon. In the case of Washington Toxics, et al v. EPA there are rulings now calling for buffers along salmon streams when either ground or aerial spraying of these pesticide. **See the Fact Sheet about Pesticides, Salmon, and Endangered Species Act herein Attachment G ; the News Press Release from Earthjustice July 17, 2003 as Attachment H - the court order signed on July 16, 2003 as Attachment I; and the court order signed August 8, 2003 as Attachment J.**

The Fact Sheet may also be found at:
http://www.earthjustice.org/news/documents/7-03/salmon_lawsuit_factsheet.pdf

H3-9

The News Press Release may be found at:
http://www.earthjustice.org/news/print.html?ID=635

The July 17th Order may be found at:
http://www.pesticide.org/Order7-16-03.pdf

The August 8th Order may be found at:
http://agr.wa.gov/PestFert/EnvResources/docs/OrderFurtherInjunctiveRelief8-8-03.pdf

The Draft EIS does not adequately address the impacts to salmon. Although the BLM chooses not to consider the salmon an irretrievable resource, once lost, we will never get them back. By choosing chemical management, the BLM is sacrificing an endangered species for sake of saving money for private cooperators.

BLM PUBLIC FUNDING OF SEED ORCHARDS NOW BENEFITING PRIVATE TIMBER AND SEED COMPANIES AT PUBLIC EXPENSE

H3-10

As far as I can find out, there was never a NEPA process whereby the public was invited to comment on the impacts of giving use of public property (the orchards of BLM) without compensation for establishment of the orchards (paid for by public funds) to private timber and seed companies to profit by the original expenditure of Federal Funding to establish the public seed orchard for the growing of trees to replant the public lands which were harvested. The BLM does not need to replant large acreages as it once did. Private timber companies can afford to pay more for the seeds for trees to replant the large acreages that it has harvested at great private gain on private lands.

H3-11

Now the BLM is spending huge sums of money to develop EIS's to justify using chemicals on public land rather than funding research into the alternatives to chemical management. With all the health concerns, the environmental concerns and the new endangered species concerns, these funds spent on justifying chemical use instead of research into the alternatives is a waste of public funds.

H3-12

Damage from contamination of water, air and soil is unjustifiable. Destruction of non-target organisms is unnecessary and inconsistent with goals to maintain ecosystem balance or biodiversity.

There is no need or justification for destroying salmon habitat, or for killing salmon to produce seed cheaply. The BLM has spent millions on protection and restoration of salmon habitat in other programs that it conducts (such as the fish ladder on Lake Creek at the Hult Reservoir, and at Triangle Lake), which is defeated by killing salmon and destroying salmon habitat at the Tyrrell, Provolt, Spague and/or Horning Seed Orchards.

CONCLUSION

H3-1

H3-2

Therefore, the BLM should adopt the Non-Chemical Pest Management Alternative, and add to the list of prohibited substances, the biopesticides such as Bacillus *thuringiensis* pesticide formulas.

Respectfully submitted by,

Jan Wroncy

Jan Wroncy, on my own behalf, and
on behalf of Coast Range Guardians, and
Canaries Who Sing
Post Office Box 1101
Eugene, OR 97440

Appendix F
NOAA Fisheries Biological Opinion Transmittal Letter and Biological Opinion

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to NOAA Fisheries No.:
2004/00205

December 21, 2004

Mr. Denis Williamson
Salem District Manager
U.S. Bureau of Land Management
1717 Fabry Road
Salem, Oregon 97306

Re: Endangered Species Act Interagency Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Proposed Integrated Pest Management Program at the Horning Seed Orchard, Clackamas County, Oregon

Dear Mr. Williamson:

The enclosed document contains a biological opinion and conference opinion (Opinion) prepared by NOAA's National Marine Fisheries Service (NOAA Fisheries) pursuant to section 7(a)(2) of the Endangered Species Act (ESA) on the effects of the proposed implementation of a five-year Integrated Pest Management Program (IPM) at the Horning Seed Orchard in Clackamas County, Oregon. The purpose of the proposed IPM program is to manage competing and unwanted vegetation, diseases, insects, and animal pests to ensure seed production from conifers, preserve individual trees, and produce native plants and seeds.

In this Opinion, NOAA Fisheries concludes that the proposed action is not likely to jeopardize the continued existence of Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*), Upper Willamette River (UWR) Chinook salmon, UWR steelhead (*O. mykiss*), LCR steelhead (*O. mykiss*), or LCR coho salmon, (*O. kisutch*), a species proposed for listing as threatened under the ESA.

The Opinion also includes an incidental take statement with terms and conditions necessary for minimizing the impact of taking that is reasonably likely to be caused by this action. Take from actions by the action agency and contractors, if any, that meet these terms and conditions will be exempt from the ESA take prohibition. However, the incidental take statement does not become effective for LCR coho salmon until NOAA Fisheries adopts this conference opinion as a biological opinion, after the listing is final. Until the time that the species is listed, the prohibitions of the ESA do not apply.

This document also includes the results of our consultation on the action's likely effects on essential fish habitats (EFH) pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes conservation recommendations to avoid, minimize, or otherwise offset potential adverse effects to EFH. Section 305(b)(4)(B) of the MSA requires Federal agencies to provide a detailed written response to NOAA Fisheries within 30 days after receiving these recommendations. If the response is inconsistent with the recommendations, the Bureau of Land Management must explain why the recommendations will not be followed, including the justification for any disagreements over the effects of the action and the recommendations.

Please direct any questions regarding this letter and the enclosed documents to Dan Tonnes at 206.526.4530, or Dan.Tonnes@NOAA.gov.

Sincerely,

for Michael R Crouse

D. Robert Lohn
Regional Administrator

cc: Bob Ruediger, BLM
Jeannette Griese, BLM

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Endangered Species Act - Section 7 Consultation
Biological Opinion & Conference Opinion

&

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat Consultation

Proposed Integrated Pest Management Program,
Horning Seed Orchard,
Clackamas County, Oregon

Agency: Bureau of Land Management

Consultation Conducted By: NOAA's National Marine Fisheries Service, Northwest Region

Date Issued: December 21, 2004

Issued by: f/ Michael R Crouse
D. Robert Lohn
Regional Administrator

NOAA Fisheries No.: **2004/00205**

Acronyms used in this document:

AgDrift - Agricultural Drift
BLM - Bureau of Land Management
BMPs - Best Management Practices
BRT - Biological Review Team
Bt - *Bacillus thuringiensis*
CFS - Cubic Feet Per Second
CPs - Conservation Practices
DOI - Department of Interior
EC - Effective Concentration
EIS - Environment Impact Statement
EFH - Essential Fish Habitat
EPA - Environmental Protection Agency
ESA - Endangered Species Act
ESUs - Evolutionarily Significant Units
EXAM - Exposure Analyis Modeling Systems
FMPs - Federal Fishery Management Plans
GLEAMS - Groundwater Loading Effects of Agricultural Management Systems
IPM - Integrated Pest Management
LC50 - Median Lethal Concentration
LOEC - Lowest Observed Effect Concentration
MSA - Magnuson-Stevens Fishery Conservation and Management Act
mg/L - milligrams per liter
MPI - Matrix of Pathways and Indicators
MOC - Method of Characteristics
NOAA Fisheries - NOAA's National Marine Fisheries Service
NWFSC - Northwest Fisheries Science Center
ODEQ - Oregon Department of Environmental Quality
ODFW - Oregon Department of Fish and Wildlife
ODF - Oregon Department of Forestry
OSUES - Oregon State University Extension Service
PFMC - Pacific Fishery Management Council
PPM - Parts Per Million
PFC - Properly Function Condition
RA - Risk Assessment
RM - River Mile
ROD - Record of Decision
SERA - Syracuse Environmental Research Associates
SONC - Southern Oregon/Northern California
SPMDs - Semi-Permeable Membrane Devices
SWW - Southwest Washington
USDA - United States Department of Agriculture
USGS - United States Geological Survey
VSP - Viable Salmonid Population
WTC - Washington Toxics Coalition

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INTRODUCTION

The Bureau of Land Management (BLM) owns and operates the 252-acre Walter H. Horning Orchard (Horning) near Colton in Clackamas County, Oregon, to produce conifer seedlings, preserve individual conifer trees, and produce native species plants and seed. The purpose of the proposed action is to manage competing and unwanted vegetation, diseases, insects, and animal pest at Horning. Proposed management consists of biological, chemical, cultural, and other methods to preserve and enhance seed orchard production. Collectively, these actions are referred to as Integrated Pest Management (IPM).

Federal agencies are required under section 7(a)(2) of the ESA to consult with NOAA's National Marine Fisheries Service (NOAA Fisheries) on their actions that authorize, fund or carry out activities that 'may affect' listed salmonids or designated critical habitat. From a scientific perspective, among the diverse actions that 'may affect' listed fish in the Norwest Region, pesticide and herbicide applications can be among the most complex. Many rivers and estuaries in the Pacific Northwest are contaminated with toxic chemicals. Water and sediment pollution can degrade fish habitat and impair the fitness of salmon and marine fish species. While there is a healthy volume of literature regarding some pesticide and herbicide effects to aquatic species, in some cases data for a specific pesticide/herbicide on particular salmonid species and their prey, including their diverse life-stages, is lacking. To address this, a number of scientific agencies, including the Environmental Protection Agency (EPA), the NOAA Fisheries' Northwest Fisheries Science Center (NWFSC), and various universities are continuing to conduct and publish studies that further describe pesticide and herbicide effects to aquatic species. Research within the NWFSC, particularly the Ecotoxicology and Environmental Fish Health Program,[1] is focused on contaminants that interfere with the normal function of the fish nervous system, and may therefore impair the survival or reproductive success of exposed fish. The NWFSC is continuing to develop new methods to detect developmental abnormalities in fish that have been exposed to common environmental chemicals.

On January 22, 2004, the U.S. District Court for the Western District of Washington ruled in the case of *Washington Toxics Coalition (WTC) v. EPA*. For ground pesticide applications, the court issued an order that establishes a 20-yard buffer zone. For aerial pesticide applications, the court order establishes a 100-yard buffer zone. These buffers are applicable beside salmon-supporting waters around certain waterbodies in California, Oregon, and Washington to which specific pesticides cannot be applied.

Chief Judge Coughenour issued this order in response to the WTC's July 16, 2003, motion for injunctive relief to establish buffer zones as an interim measure to reduce the likelihood of jeopardy to 26 species of salmon and steelhead. This order is in effect until the EPA and NOAA Fisheries have completed an evaluation of threatened and endangered Pacific salmon and steelhead and their critical habitats to exposure from 55 pesticides. Under the ESA, EPA must

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[1] http://www.nwfsc.noaa.gov/research/divisions/ec/ecotox/index.cfm

ensure that its registration of a pesticide is not likely to jeopardize the continued existence of species listed as endangered and threatened or adversely modify habitat critical to those species' survival. In addition to the obligation to ensure that its actions are not likely to jeopardize listed species, the EPA must consult, as appropriate, with the U.S. Fish and Wildlife Service (USFWS) or NOAA Fisheries if a pesticide's use may affect listed species or designated critical habitat.

Background and Consultation History

This five-year consultation for Horning was initiated by the BLM to help streamline the implementation of a comprehensive IPM program. For the past two years, the BLM and NOAA Fisheries have conducted coordination meetings and correspondence to review and refine the proposed action, review draft versions of the biological assessment (BA), the Risk Assessment (RA) and the draft Environment Impact Statement (EIS). Pre-consultation coordination is summarized below. Most of the listed meetings also discussed the other seed orchards that will undergo separate consultation with NOAA Fisheries. The other seed orchards are Provolt, Sprague, and Tyrrell, all in Oregon. The proposed IPM programs for all the seed orchards are generally similar.

- On October 29, 2002, BLM and NOAA Fisheries staff toured the Horning site.
- On July 10, 2003, NOAA Fisheries and the BLM held a conference call to discuss the draft EIS and information necessary for the BA.
- On August 5, 2003, NOAA Fisheries and BLM staff met to discuss structuring the BA and Opinion to facilitate multi-year consultation, among other topics.
- On August 13, 2003, NOAA Fisheries sent a letter to the BLM with comments on the draft EIS and in anticipation of future section 7(a)(2) consultation for Horning.
- On November 11, 2003, NOAA Fisheries sent comments through electronic mail on the draft BA.

In addition to the above, many phone calls and e-mails were exchanged between NOAA Fisheries and the BLM regarding the proposed action. The BLM, at the request of NOAA Fisheries, tailored their assessment of the IPM with technical guidance drafted by the NWFSC for NOAA Fisheries section 7 pesticide and herbicide consultations. The BLM provided several versions of the draft BA, risk analysis, and monitoring plans for NOAA Fisheries review and comment. In addition, the BLM reviewed draft versions of the proposed action and reasonable and prudent measures found in this Opinion. Correspondence related to this consultation is available within the administrative record, at NOAA Fisheries' Oregon State Habitat Office in Portland, Oregon.

NOAA Fisheries received a letter dated March 2, 2003, and an accompanying BA from the BLM requesting informal consultation on the proposed five-year IPM program for the Horning orchard. In the letter and the BA, the BLM determined that the proposed action is 'not likely to adversely affect' (NLAA) UWR and LCR steelhead ESUs. In March 2004, NOAA Fisheries informed the BLM the proposed IPM program was 'likely to adversely affect' (LAA) UWR and LCR steelhead, and recommended formal consultation for the proposed action. During the

review of the proposed IPM, NOAA Fisheries determined that the proposed action is also LAA for LCR and UWR Chinook salmon (*O. tshawytscha*), which are listed as threatened under the ESA, and are found 12 to 16 miles downstream from the project area. Also during development of the Opinion, NOAA Fisheries proposed LCR coho salmon *(O. kisutch*) for listing as threatened under the ESA. As such, this document also serves as a conference Opinion on whether the proposed action is likely to jeopardize the continued existence of LCR coho salmon.

This document also fulfills the essential fish habitat (EFH) consultation requirements under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (1996). The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a Federal fisheries management plan. Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2)). The objective of the EFH consultation is to determine whether the proposed action will adversely affect designated EFH for Chinook and coho salmon, and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH resulting from the proposed action.

The action area for this consultation includes streams in the Section 13 portion of the orchard, Swagger Creek, Clear Creek, and the lower Clackamas River to its confluence with the Willamette River. In addition, the action area includes streams in the Section 23 portion of the orchard and Milk Creek to its confluence with the Molalla River.

Description of the Proposed Actions

Management of pests enables the seed orchard to produce improved seed for conifer seedling production, preserve valuable individual conifer trees, produce native species plants and plant species seed, and produce containerized seedlings in a greenhouse nursery. This seed is supplied to BLM and other cooperators for reforestation and restoration projects.

The pest management objectives at Horning include the following:

1. Minimize insect damage to orchard trees, cone crops, native plants, and greenhouse seedlings.
2. Remove noxious weeds and control vegetation that favors animal pests and disease conditions, and reduce fire hazard conditions.
3. Reduce growth of vegetation to allow tree establishment and growth, and reduce the fire hazard.
4. Treat fungal and bacterial diseases to maintain the health and vigor of the orchard trees used for seed production and control plant pathogens in the greenhouse and native seedling grow-out beds.
5. Minimize animal damage to orchard trees, native plant beds, greenhouse seedlings, and orchard equipment and infrastructure.

The BA states that it is the policy of the Department of Interior (DOI) to use chemical pesticides only after considering all the alternatives, and to develop, support, and adopt IPM strategies wherever practicable (DOI 1981). The definition of IPM used in the BA is as follows:

> IPM is an approach to solving pest problems by applying our knowledge about pests to prevent them from damaging crops, harming animals, infesting buildings or otherwise interfering with our livelihood or enjoyment of life. IPM means responding to pest problems with the most effective, least-risk option. Under IPM, actions are taken to control pests only when their numbers are likely to exceed acceptable levels. Any action taken is designed to target the troublesome pest, and limit the impact on other organisms and the environment. Applying pesticides to crops, animals, buildings or landscapes on a routine basis, regardless of need, is not IPM (BLM 2004).

The BA further defines the context for the proposed Horning IPM, emphasizing the holistic approach to pest management consistent with DOI policy, and the integration of a broad range of pest control methods:

> IPM for seed orchards is the maintenance of seed orchard pests at tolerable levels by the planned use of a variety of preventive, suppressive, or regulatory methods (including no action) that are consistent with orchard management goals. Each pest management activity is the end result of a decision-making process where pest problems and their impact on hosts are considered, and control methods are analyzed for their effectiveness, as well as their impacts on economics, human health, and the environment. Deciding which particular method would be used depends on several factors. Initial questions at the seed orchard might include, 'Is it really necessary to control this pest? Can we live with the damage and still have the trees survive and produce suitable amounts of seed?' If the answers are yes and no, respectively, then decisions must be made as to what method(s) of control to use.
>
> The focus of IPM is on long-term prevention or suppression of pests. The integrated approach to pest management incorporates the best-suited biological, chemical, and cultural controls that have minimum impact on the environment and on people. IPM is not pesticide-free management; however, a successful IPM program should result in the most efficient use of pesticides if and when they are needed (BLM 2004).

The BLM proposed a number of specific measures to address unwanted vegetation, insects, disease, and animal pests at Horning. These measures generally fall into the following categories:

- Biological controls, such as bird or bat boxes to attract insect-eaters, or encouraging predators that can control animal pests.
- Prescribed burning to remove vegetation.
- Cultural methods, including mechanical (tractor mowing) and manual (pruning) methods, mulch mats, and fences.

- Chemical insecticides, herbicides, fungicides and fertilizers.

Biological Controls

Biological pest control is the deliberate use of natural enemies such as parasites, predators, or disease organisms to reduce pest populations. Four types of biological control are in use, or proposed for use, to manage insect pests:

1. Bird boxes are placed on perimeter fences throughout the orchard. Birds are seen predating insects throughout the year, though their overall effect has not been quantified.
2. Bat houses have also been placed throughout Horning to provide roosting and breeding habitat to encourage bats, such as the big brown bat and little brown myotis, to live in the vicinity and feed on insects in Horning.
3. *Bacillus thuringiensis* (Bt), a biological insecticide, has been used in the greenhouses and is being considered to help reduce insect damage at the orchard.
4. Grazing using sheep, goats, or cattle could also be used to help control undesirable vegetation. Cattle and sheep grazing has been used in past years in the orchard units to reduce vegetation.
5. Planting fallow crops or cover crops in the rows between orchard trees also can limit growth of undesirable vegetation and noxious weeds.

Prescribed Burning

The BLM proposed that prescribed fire may be used for removing vegetation in native species beds before planting or in limited areas in some orchard units. High temperatures created through the use of a propane-fueled flame wand, kill any existing herbaceous material, providing a weed-free bed for growing native plants, and quickly removing dead plant litter. Pile burning may be used to dispose of cut or cleared vegetation or spent sugar pine cones. Grass straw may also be burned between the rows in the native plant garden to control disease. Prescribed fire is not proposed for use in riparian areas.

Cultural Methods

The following methods may be used for various applications:

1. <u>Vegetation</u>: Hand-pulling, non-powered and powered hand tools to cut and clear, tractors with various blade attachments for mowing, gasoline-powered string trimmers, tilling an un-vegetated buffer around native plant beds, and mulch mats.
2. <u>Disease</u>: Pruning, thinning, stump grinding. In greenhouses, knocking or blowing water off seedlings and control of air flow through the use of fans and convection tubes.
3. <u>Animal pests</u>: Trapping of gophers, porcupines, and other small mammals, fencing that excludes deer and elk from the orchard, Vexar™ tubes to protect seedlings, use of sticky traps in greenhouses, screening to exclude squirrels from seed extractory and cone shed.

Chemical Pesticides (insecticides, herbicides, fungicides and fertilizers)

Table 1 lists the following chemical pesticides, herbicides, and fertilizers proposed for use at Horning.

Table 1. Proposed pesticides for use at Horning

Insecticides	Fungicides	Herbicides	Fertilizers
acephate chlorpyrifos diazinon dimethoate esfenvalerate horticultural oil imidacloprid permethrin potassium salts of fatty acids (Safer® Soap) propargite (miticide)	chlorothalonil hydrogen dioxide mancozeb propiconazole thiophanate-methyl	dicamba glyphosate picloram	ammonium nitrate ammonium sulfate mono-ammonium and diammonium phosphate calcium nitrate potassium nitrate potassium chloride potassium sulfate

Table 2 provides the relative toxicity to salmonids and insects, and application data as proposed the BLM

Table 2. Pesticide, herbicide and fertilizer data

Pesticide	Chemical Family	Pest. Use	Fish Acute Toxicity	Application Date Range	Application Frequency	Application Method
Acephate	Organo-phosphate	I	Slightly toxic	Apr-May	Every 1 to 3 years	Implants
				Apr-Sep		HPHS or HSHHW
				Jun-Sep		HS
				Jun-Sep		Total-release canisters
B.t.	Biological	I	No Data Available	Apr - Sept	Annually	HPHS or HSHHW
Chlorpyrifos	Organo-phosphate	I	Very highly toxic	Apr - Sept	1 to 2X in a 10 year period	Airblast

Pesticide	Chemical Family	Pest. Use	Fish Acute Toxicity	Application Date Range	Application Frequency	Application Method
Diazinon	Organo-phosphate	I	Very highly toxic	Apr - Sept	1 to 2X in a 5 year period	HPHS
Dimethoate	Organo-phosphate	I	Slightly to moderately toxic	Apr - Jun	Only if Esfenvalerate unavailable	HPHS
Esfenvalerate	Pyrethroid	I	Very highly toxic	Apr - Jul	Annually	Aerial
				Apr - Jun		Airblast
				Apr - Jun		HPHS -or- HSHHW -or- BS
Horticultural Oil	Petro-Chem	I	Moderate to highly toxic	Mar - Sep (as additive) Sep - May (dormant oil)	Every 1 to 2 years as an alt or supplement to non-chemical treatment	HPHS
Permethrin	Pyrethroid	I	Very highly toxic	May - Aug	Only if Esfenvalerate unavailable	Airblast
						HPHS
Potassium Salts of Fatty Acids	Fatty Acids	I,F,H	Slightly toxic	Apr - Sept	Every 1 to 2 years as an alt or supplement to non-chemical treatment	HS
Propargite	Organosulfite	I	Highly Toxic	Apr-Oct	1 to 2X in a 10-year period	HPHS
Chlorothalonil	Chlorinated benzene nitrile	F	Very Highly Toxic	Feb - Jun	1 to 2X in a 10-year period	HPHS
				May - Dec	Every 2 weeks	Chemigation or HS
Hydrogen dioxide	Peroxy Compound	F	Very highly toxic	Mar - Jan	Every week	Chemigation

Pesticide	Chemical Family	Pest. Use	Fish Acute Toxicity	Application Date Range	Application Frequency	Application Method
Mancozeb	Dithiocarbamate	F	Moderately toxic	May - Nov	Every 1 to 2 years as an alt. or supplement to non-chemical treatment	Chemigation -or- HS
Propiconazole	Triazole	F	Moderately toxic	Mar - Nov	1 to 2X per year	Tractor-pulled spray rig w/ boom -or- HSHHW
Dicamba	Benzoic acid derivative	H	Slightly toxic	May - Sept	Back up or Alt. to glyphosate or for persistent weeds	Tractor-pulled spray rig w/ boom -or- HSHHW -or- BS
Glyphosate (roundup)	Amino acid derivative	H	Moderately toxic	Apr - Jul	Initially 2 to 3X per year, as plant pop. diminish, then 1 to 2X per year	Tractor-pulled spray rig w/ boom -or- HSHHW
				Mar - Oct		BS
Glyphosate (rodeo)	Amino acid derivative	H	Moderately toxic	Mar - Oct		BS
Picloram	Picolinic acid derivative	H	Slightly to moderately toxic	May - Aug	1 to 2X in a 10-year period	HSHHW -or- BS
Triclopyr	Amine salt	H	Slightly to moderately toxic	May - Aug	1 to 2X in a 10-year period	BS
Dazomet	Thiozine	F	Moderate to highly toxic	Apr - Jul	Annually or less	Ground pull spreader

Relative fish toxicity as determined by the Pesticide Action Network (PAN)[2]

KEY:
I = insecticide, F = fungicide, H = herbicide
HSHHW=Hydraulic Sprayer with Hand Held Wand, BS=Backpack Sprayer, HPHS=High Pressure Hydraulic Sprayer, HS=Hand Sprayer

[2] PAN can be accessed at: http://www.pesticideinfo.org/Index.html

Proposed Conservation Practices (CPs)

- No pesticide will be applied through aerial, airblast, or high-pressure hydraulic sprayer methods within 200 feet of perennial or intermittent streams to limit the potential for drift. From the edge of the 200-foot buffer to 50 feet from the streambank, pesticide application will be limited to methods that preclude drift. These methods could include backpack sprayers with wicks or wands, implants, and foams or other no-drift technologies.
- From the streambank to the 50-foot buffer area, only cultural methods, implants, injections, stump painting, and hand-held wands with wicks will be used to control highly invasive weeds. However, herbicide application with a backpack sprayer may also be used to treat noxious weeds if the plant populations become large enough and treatment by hand-held wick and injection has not proven to be effective in controlling the plants at that location. Chemical treatments will only be used on highly invasive, non-native species, such as knotweeds (Japanese, Himalayan, and giant), and purple loosestrife, that will not be effectively controlled with other methods.
- Pesticides will be applied within the parameters of prescribed environmental conditions stated on the label.
- Temperatures will be monitored carefully.
- No spraying will occur if snow or ice covers the target foliage.
- If possible, spraying will be conducted during the early morning or late evening, allowing foliage to dry before pollinators become active.
- Orchard fields will be mowed or grazed before insecticide applications, to remove floral components on ground cover that will attract pollinators, such as bees (only if pollinators are active).
- Chemical weed control within 20 feet of perennial or non-perennial streams with flowing water at the time of application will be limited to spot hand applications.
- Application for invasive weeds within the area of the streambank will be made by properly licensed applicators using only the Rodeo® formulation of glyphosate. These treatments will include precautions such as application during lowest flow, spray shields to protect any open water, and transportation of only the required small amounts of the product to the application site to limit the potential for spill impacts. In stream reaches where foliar applications of Rodeo® are used to treat knotweed growing in dry portions of the stream channel below the ordinary high water elevation, application is limited to the dry portions of the stream channel in the preferred in-water work period, in accordance with Oregon Department of Fish and Wildlife (ODFW) guidance.
- To avoid the potential for rapid transport to the aquatic system, only application for control of invasive weeds (as described in the previous paragraph) will occur within the grassed waterway zones containing tile. These tile zones will be marked on the ground. The width of the buffer along these tiled waterways could vary based on the topographic condition of the tiled area; however, a minimum of 25 feet on each side of the tile zone will be used. The tile zones will not be mowed, to allow the development of a grass and shrub canopy that can assist in capturing any drift from adjacent application areas.

- Aerial application in adjacent seed production orchards will be designed to minimize drift into the tile zones by not applying aerially in certain portions of the orchard units. In native plant areas, the tile zones will be used to produce riparian species without the application of pesticides; these species could assist in preventing any mobile chemicals contained in overland runoff from entering the stream system. If water quality monitoring indicates the presence of any applied pesticides in the tile zones, temporary control of drainage in the specific tile will be implemented and pesticide application in the drain tile area will be discontinued until appropriate controls are designed to avoid introduction into tile.
- No carrier other than water will be used to mix (dilute) the pesticide products for application. In some cases, surfactants or adjuvants may be added to application mixtures of pesticides to improve their effectiveness or minimize handling and application problems. The seed orchard will only use surfactants or adjuvants that do not contain any ingredients on EPA's List 1 or 2, where listing indicates a chemical is of toxicological concern, or is potentially toxic with a high priority for testing (EPA 2000a). If a surfactant or adjuvant that contains any List 1 or 2 ingredients is considered, the risk associated with that chemical will be evaluated before a use determination is made.
- Maintenance and calibration of spray equipment will occur at least annually to ensure proper application rates.
- No more than one application of picloram will be made on an area in any given year to reduce the potential for picloram accumulation in the soil.
- Permethrin and Esfenvalerate will not be used in the same year.

<u>Proposed Runoff CPs</u>.

- Applications will be timed, to the extent predictable by weather forecasts, to not coincide or closely precede a large storm event that could result in substantial runoff. Specifically, there will be no application of pesticides when rainfall is expected to exceed 0.5 inch per hour within the three days following application. This is the most reliable forecast window and will minimize the likelihood of exceeding the infiltration rates of the dominate orchard soil. Application will not occur on days that rainfall or fog is likely to occur.
- Soil aeration equipment will be used in orchard blocks before aerial or airblast application to promote rainfall infiltration into the soil surface and decrease risk of runoff, as weather conditions permit.
- If rain has preceded an intended application window, units will be checked for their infiltration capacity, avoiding application when standing water is visible on the soil surface.
- At a minimum, streamcourse and wetland buffers will be established within guidelines prescribed by the pesticide label.
- No chemical pesticides will be applied to road or ditch surfaces that directly contribute to stream channel flow, nor to fencelines within 50 feet on either side of stream channels.
- Silt catchment barriers, such as bio-bags, will be installed across all ephemeral drainages beside or inside treatment units during periods when overland flow may occur following

pesticide application. The function of these barriers will be to catch organics and sediment leaving the treatment area.

Proposed Spill CPs.

- Equipment used for pesticide transport, mixing, and application will be properly maintained to avoid leaking pesticides into water or soil.
- Pesticides will be mixed and equipment cleaned in areas protected (*i.e.*, paved and bermed, or on a portable bermed mixing pad) from the potential for runoff to surface waters or leaching to groundwater in the case of a spill. Chemical containers will be kept in plastic drip pans that are large enough to hold the entire volume of each container in case the containers develop leaks.
- To prevent the impacts to aquatic species associated with a spill, chemical pesticides will not be transported by air or ground over the perennial tributaries to Nate Creek (which is a tributary to Milk Creek) in Section 23.
- To prevent impacts to aquatic species associated with a spill, tank-mixed pesticides will not be transported along the gravel road east of orchard unit B14 within 50 feet of the stream channel.
- All chemical loading operations will occur within the orchard building compound, except for applications planned for the area north of the Swagger Creek (which is a tributary to Clear Creek) tributary in Section 13. Applications to be made in this area will be prepared in a mixing area 500 feet from stream channels in that subsection. The pesticide to be used will be brought over to this area in a spill containment enclosure and only the amount needed for the tank mix will be transported. Tank-mixed insecticides or fungicides will not be transported by ground over the perennial tributary to Swagger Creek in Section 13.
- A spill containment kit will be onsite in the orchard building compound.
- Procedures outlined in an orchard Spill Prevention, Containment, and Countermeasure Plan will be followed if there is any spill of oil or hazardous materials, including pesticides.

Proposed Drift CPs.

- All applications of liquid pesticides will occur early in the morning when wind is minimal (<6 mph). Wind speed will be monitored on-site before and during spray applications. Operations will be suspended if wind speeds exceed 6 mph. Application will not occur when wind direction is toward flowing streams.
- Factors such as relative humidity, wind speed, and air temperature will be considered to determine the timing of applications that will minimize the potential for off-target drift.
- Pesticide applications will not be made during temperature inversions.
- Drift cards will be placed on all sides of areas to be treated when liquid pesticides are used, and applications will cease if there is any indication that chemical is moving out of the target area.

- When spraying trees within two tree rows from the edge of treatment unit perimeters, spraying will be done by directing the nozzle towards the center of the treatment unit, minimizing the chance for drift outside the designated treatment areas.

Proposed Aerial CPs.

- Before reconnaissance and operational flights, BLM will discuss objectives and concerns with the pilot performing the operation. The project boundaries will be reviewed using aerial photos and appropriate maps on the ground by the pilot and BLM project leader immediately before beginning application.
- BLM will clearly mark the application units and buffer boundaries with visible cones and flagging in such a manner that will allow visual identification from the air. BLM will deploy smoke flares in each unit before application to provide for pilot recognition of wind speed and direction.
- BLM will place drift cards along all sensitive buffers and along stream channels where drift or drip entry is possible. These will generally be placed along stream buffers and under the designated flight path when crossing the main tributary to Swagger Creek (Stream 6).
- Flight paths during operation will not be over surface waterbodies except for a designated corridor across Stream 6.
- BLM will flag a designated corridor for a helicopter flight path across Stream 6. The helicopter will travel from the load area to application areas in units north of Stream 6 using this corridor, making the least number of crossings possible. This is intended to reduce the potential for drip to enter Stream 6.
- Any reconnaissance flights over water bodies will be made with empty tanks.
- Areas immediately beside no-spray buffers will be treated before spraying the remainder of the unit. Initial application flight paths will be flown parallel to the buffer with the boom closest to the sensitive area turned off during the nearest pass. This will reduce the likelihood of accidental overspray into buffer areas with stream channels.
- To minimize the potential for overspray and drift, the pilot will avoid any banked turns against the protection buffers.
- The minimum practical boom length should be used, and must not exceed 75% of the rotor diameter.
- Aerial applications will be designed to deliver a median droplet diameter of 200 to 800 microns to reduce drift.
- Spray will be released at the lowest height consistent with pest control and flight safety. This will optimize the amount of spray reaching the target trees and reduce the amount reaching the ground.
- Spray 'clean out' areas will be designated in orchard units B50 and B11 (greenhouse effluent irrigation area) or in areas which have no flowing streams within 500 feet.

Proposed Application Methods. Pesticides may be applied using several methods, including: (1) Aerial (helicopter), (2) airblast sprayer, (3) high-pressure hydraulic sprayer, (4) hydraulic sprayer with hand-held wand,(5) tractor-pulled spray rig with boom, (6) backpack sprayer (hand-held wick), (7) capsule implantation, (8) granular spreaders, (9) hand sprayer (greenhouse only), (10) chemigation (greenhouse only), (11) total-release canister (greenhouse only), and (12) greenhouse effluent irrigation.

Each method is described briefly in the following paragraphs.

Aerial Application. A helicopter is equipped with a pesticide tank for aerial application of liquid mixtures. The size and type of helicopter may vary - based on the local contractor's current equipment. Aerial methods may be used to apply the insecticide esfenvalerate to active orchard units.

Airblast Sprayer. Airblast sprayers are pulled behind a tractor or a truck. Airblast sprayers use fans or blowers to propel spray mixtures into dense foliage or the tops of trees. The nozzles of airblast sprayers are positioned in the air stream to break up spray droplets and propel them into the tree tops. At Horning, an airblast sprayer may be used to apply the insecticides chlorpyrifos, esfenvalerate, or permethrin to orchard units.

High-Pressure Hydraulic Sprayer. High-pressure hydraulic sprayers consist of a powered pump and tank carried by truck or tractor, and hand-held nozzles for dispersing the solution upward into the tree. These sprayers could be used to treat individual mature trees with the insecticides acephate, diazinon, dimethoate, esfenvalerate, permethrin, horticultural oil, or propargite, or with the fungicide chlorothalonil.

Hydraulic Sprayer with Hand-Held Wand. A spray tank is mounted on a truck, tractor, or all-terrain vehicle (ATV), and may be used to apply herbicides around trees in orchard units, along fence-lines, and as a spot treatment in fallow fields, orchard units, and administrative areas. The sprayer may be operated by one worker, who drives and stops to spray, or by two workers, with one driving and the other spraying. This method may be used to apply the insecticides acephate or esfenvalerate, the fungicide propiconazole, or the herbicides glyphosate, picloram, or dicamba.

Tractor-Pulled Spray Rig with Boom. This method may be used to apply herbicides for control of weeds in orchard units, in roadways, or in fallow areas. Equipment consists of a hydraulic spray tank pulled by a tractor or heavy-duty pickup truck, with a spray boom attached to the tank to release the herbicide. At Horning, this method may be used to apply the herbicides glyphosate or dicamba; or the fungicide propiconazole.

Backpack Sprayer. A backpack sprayer consists of a plastic tank containing the pesticide that is strapped to the applicator's back. A hand-operated hydraulic pump forces the liquid from the tank through a nozzle in a hand-held wand. At Horning, a backpack sprayer

could be used to apply the insecticide esfenvalerate; or the herbicides glyphosate, or picloram, for spot treatment of unwanted vegetation in orchard units and along fence-lines.

Capsule Implantation. The insecticides acephate and imidacloprid may be implanted into individual trees for long-term control of insect pests in the form of a capsule. One small hole is drilled into a tree for every 4 inches of circumference, and a capsule is inserted.

Granular Spreaders. Granular fertilizers or the granular fumigant dazomet may be distributed over the ground using a spreader pulled by a truck or tractor, or mounted on an ATV. Broadcast or sidecast spreaders will be used for general fertilizer (nitrogen/phosphorus/sulfate) applications. Sidecast or drop spreaders will be used to apply calcium nitrate to the dripline of trees for stimulating flower production. A broadcast spreader will be used to apply the fumigant dazomet, after which the granules will be incorporated to a depth of 4 to 8 inches, depending on targets to be controlled (*i.e.*, annual weeds, specific soil-borne pathogens). Fertilizer application needs and rates for each orchard unit are determined based on the results of annual foliar analyses.

Hand Sprayer. A hand sprayer consists of a 1- to 2-gallon plastic container with a hand-operated trigger and wand. A hand sprayer may be used to apply the insecticide acephate or the fungicides chlorothalonil, mancozeb, and thiophanate-methyl in the greenhouse.

Chemigation. Chemigation is the process of injecting pesticide into the irrigation system, so that it is applied with the irrigation water. At Horning, chemigation is only used in the greenhouse. This method may be used to apply the fungicides chlorothalonil, hydrogen dioxide, mancozeb, or thiophanate-methyl to greenhouse plants. For foliar applications such as these, the pesticide is added to the irrigation water at the end of the irrigation cycle, to minimize washoff and maximize efficacy.

Total-Release Canister. One formulation of the insecticide acephate may be used in the greenhouse in the form of total release canisters, or 'foggers.' The cans are placed evenly throughout the greenhouse, and a tab release is pressed. The greenhouse is evacuated. The entire contents of each can are released automatically.

Greenhouse Effluent Irrigation. The effluent from greenhouse operations will be collected in a holding tank. This effluent will consist of excess irrigation water, including washoff containing greatly diluted residues of the fertilizers and pesticides used in the greenhouses. Greenhouse pesticides are acephate, chlorothalonil, hydrogen dioxide, mancozeb, and thiophanate-methyl. A typical effluent irrigation amount is estimated to be 4,800 gallons over three hours. The maximum volume is estimated to be 9,600 gallons in two, 3-hour increments.

Rate/Frequency/Volume and Locations of Applications. The BLM provided application data for each pesticide proposed for use at Horning over the proposed five-year term of the consultation. Table 3, below, details the data for the pesticide permethrin, and is included

here as an example of data provided for all pesticides in the BA. All of the tables can be viewed within the BA.

Table 3. Pesticides application data - Horning

Application Method	Location	Typical Application Rate and Area	Max. Label Application Rate and Max. Area	Application Date Range	Application Frequency
Esfenvalerate: Asana® XL (8.4% a.i. as an emulsifiable concentrate) Target pests: Douglas-fir cone moth, cone worm, seed bug, seed chalcid, pine conelet bug, pine needle midge, spruce budworm, balsam					
Aerial (helicopter)	Seed production orchards	0.19 lb a.i./acre, in water at 10 gal/acre 1 application to 75 acres	0.19 lb a.i./acre, in water at 10 gal/acre 2 applications to 150 acres	Apr - Jun	Annually, rotating among units
Airblast sprayer	Seed production orchards	0.05 lb a.i./acre, in water at 100 gal/acre 1 application to 75 acres	0.088 lb a.i./acre, in water at 175 gal/acre 2 applications to 150 acres	Apr - Jun	
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Individual trees in any orchard	0.001 lb a.i./tree, in water at 2 gal/tree 1 application to 1,000 trees	Cumulative maximum = 1.6 lb a.i./acre per year 0.002 lb a.i./tree, in water at 4 gal/tree 2 applications to 1,000 trees	Apr - Jun	

Table 4 lists the proposed no-application buffers at Horning.

Table 4. BLM Horning proposed minimum no-application buffers

Pesticide	Application Method	Buffer (ft) from waterway
Esfenvalerate	Aerial	200
Chlorpyrifos Esfenvalerate Permethrin	Airblast sprayer	200

Pesticide	Application Method	Buffer (ft) from waterway
Acephate B.t. Diazinon Dimethoate Esfenvalerate Horticultural oil Permethrin Propargite Chlorothalonil	High-pressure hydraulic sprayer	200
Propiconazole Dicamba Glyphosate (Roundup®)	Tractor-pulled spray rig with boom	200
Acephate B.t. Esfenvalerate Picloram Propiconazole	Hydraulic sprayer with handheld wand	50
Esfenvalerate Dicamba Glyphosate (Roundup®) Picloram	Backpack sprayer	50
Potassium salts of fatty acids	Hand sprayer	50
Glyphosate (Rodeo®) – for invasive weeds only	Backpack, hand-held wick, injection	streambank
Acephate Imidacloprid	Capsule implantation	50

Annual Monitoring and Reporting Requirements

The BLM has proposed a methodology for water quality monitoring whenever a pesticide or fertilizer covered under the BA is proposed for use. The plan covers four types of monitoring: (1) Implementation monitoring, (2) effectiveness monitoring, (3) validation monitoring, and (4) compliance monitoring.

The overall objective of the monitoring program at Horning is to document the impacts of IPM actions on water quality, and to use this information to continue or modify the protection measures needed to meet the requirements for a healthy aquatic ecosystem. A full assessment of protection measures used in Horning requires monitoring both groundwater and surface water.

Implementation Monitoring. All pesticide applications will be documented by Horning's manager or designated representative. Items to be documented include the type of chemical applied, the date of application, the method of application, the area treated, the amount applied, precipitation amounts for the three days preceding and following application, the

location used for mixing and loading, wind direction and speed, relative humidity, air temperature, and notes regarding whether any leakage or spills occurred. A list of all protection measures and limitations for each orchard unit receiving pesticide or fertilizer application will all be provided in the Annual Horning Monitoring Report.

Implementing protection measures and analyzing monitoring data of all types depends heavily on quality climate information. Maintenance of the existing seed orchard weather stations will continue providing real-time climate data including air temperature, precipitation, wind speed, wind direction, and relative humidity. These data will provide documentation of compliance and information to predict runoff patterns for effectiveness and validation monitoring.

Monitoring of Effectiveness of CPs.

Drift Card Monitoring. All orchard units beside flowing streams and planned for aerial, airblast, high-pressure hydraulic sprayer applications, and select hand-held spray applications will have spray cards placed, such that drift from the application can be captured and characterized. Where the application unit is in direct proximity to a flowing stream, cards will be placed at a maximum of 50-foot intervals along the edge of the unit before the application. Where open canopy occurs in the stream buffer, drift cards will be placed to characterize potential intrusion of drift toward channels. Immediately after the application, the cards will be collected and reviewed to determine if any ‘signature’ of drift occurred, the extent of the drift, and the potential for contamination of the adjacent stream or wetland. A copy of all the cards will be kept on file at Horning, along with a record of their location and all the compliance monitoring documentation.

Surface Water Monitoring. For aerial, airblast, and high-pressure hydraulic sprayer applications, water samples will be taken in streams before and after spray application as per the Oregon Department of Forestry (ODF) (1997) protocols and site-specific ‘time of concentration’ measurements. Selection of sampling stations for surface water sampling will be based on the proximity to application areas. For aerial spray treatments, samples will be collected above and below the helicopter corridor when units in the north portion of Section 13 are treated.

Samples will be taken within 24 hours before application and at 15 minutes, 2 hours, 4 hours, 8 hours, and 24 hours after the first swath has been sprayed parallel to the stream of concern. The time of collection will be based on the time of concentration measurements in the flowing channels associated with the treatment areas. These measurements will be taken during the 24 hours before application. During the 24 hours after application, a series of composite samples will also be taken through the use of a continuous pumping sampler. These data will provide a 24-hour concentration to compare with the ODF calculation, water quality criteria, and literature studies.

All data will be used in conjunction with the spray cards to determine the effectiveness of the full ‘suite’ of protective measures implemented to avoid drift. Samples will be analyzed at a state-certified laboratory that has detection limits of 0.02 parts per billion (ppb) for most of the

potential pesticides. Samples will be collected in accordance with laboratory instructions. When sites are sampled, additional interpretive data will be collected for pH, specific conductance, turbidity, and temperature.

Surface Runoff Monitoring. Surface runoff from treated 'fields' at Horning can be dispersed, transient, and at times non-existent (BLM 2002). These characteristics make it difficult to plan and implement monitoring on a 'field by field' basis. The stream channels draining the fields receiving pesticide and fertilizer applications provide an alternative means to effectively and collectively sample for losses due to surface runoff. Data collected in the channels also provide a better indication of duration and level of exposure for aquatic species. For these reasons, effectiveness monitoring of surface runoff will focus on streamflow concentrations.

The selection of a specific pesticide or fertilizer to monitor for runoff will be planned annually and will depend on the chemical characteristics of the pesticide applied (with emphasis on the more mobile chemicals with higher toxicity), the amount applied, the application method, the proximity of the treatment to the stream channel, and on past monitoring results.

Pesticide and fertilizer fate modeling from the Human Health and Non-Target Species RA indicates that field runoff events within the first six months after spray application have the highest probability of carrying detectible concentrations of chemicals. One study (Rashin and Graber 1993 as referenced in BLM 2004) determined that runoff events within the first 72 hours of application were the most important in terms of increases in detectible chemical concentrations. Stream concentration sampling will be conducted during periods of precipitation that could result in field surface runoff and increases in streamflow. For Horning, this generally occurs in the late fall and winter periods, sometimes more than six months after application. These periods are most likely to carry the greatest detectible concentrations of pesticides or fertilizers in streamflow. If a surface water runoff event occurs after spring applications, these events will be sampled.

Since most future seed production areas are in Section 23, the perennial flowing streams in this section are targeted for runoff sampling. Streams 9c and 11a will have continuous flow recording stations that will collect water and suspended sediment samples on a flow-weighted basis with the intention of providing individual storm concentrations for multiple runoff events. These stations drain those seed production units where pesticide and fertilizer applications are more likely to be needed. The data from these stations will represent water quality conditions resulting from the effectiveness of implemented protective measures in the higher-risk seed production orchards.

Semi-permeable membrane devices (SPMDs) may be used in addition to, or in lieu of, the flow-weighted concentration sampling (see details of SPMD use in the Effects Analysis Section).

All data will be used in conjunction with continuous recorded climate data to illustrate the effectiveness of design features in minimizing introduction of pesticides and fertilizers to the

aquatic system. Samples will be analyzed at a state-certified laboratory that has detection limits of 0.02 ppb for most of the potential pesticides. Samples will be collected in accordance with laboratory instructions.

Subsurface Runoff Monitoring. The orchard contains approximately 1,500 feet of subsurface field tiles (perforated drain pipe) filed in orchard units identified for potential broadcast pesticide and fertilizer use. This is a concern, since water that will naturally percolate through the full soil profile (thus having significant opportunity for absorption of pesticides) is allowed to move more rapidly off-site through the tile system. This is termed 'preferential flow'; a system in which there is no proven predictive model for determining the fate of pesticides. Currently, there are no data documenting the amount of runoff moving through the tile systems or the contribution of pesticides or fertilizer from these conduits.

Previous monitoring indicates that subsurface flow could be a significant pathway for water to reach the stream system via the orchard units (BLM 2001 and BLM 2002). Since much of the drain system was installed in the 1970s and 1980s, information such as the depth and full extent of the system is unknown. As a conservative measure, management buffers are planned along tile drain 'corridors.' These management buffers preclude broadcast spray of pesticides and fertilizer until more is understood about the drain flow rates, linkage to surface flow, and the associated chemical concentrations. Monitoring the drain pipes will provide an indication of the effectiveness of the drain buffers and over time will provide information for planning any future application needed within the corridors.

Drain pipe flow and chemical concentration sampling are planned for three sites in the orchard. Tile site 1 is a control with no previous application of pesticide and no planned application in the future, except for herbicide spot spray. Tile site 2 is in the tile drains in the northern portion of Section 23, draining an actively-managed seed production orchard. Tile site 3 is in the tile drain in the native seedbeds in Section 13. Continuous flow measurement will also be recorded at all three tile sites. Sampling will target flushing periods, such as during significant spring and fall storm events. These events will be most likely to mobilize pesticides in solution and sediment. Focus will be on pipe flow periods immediately after select applications and the first pipe flow after the summer application period. The selection of a specific pesticide or fertilizer to analyze will depend on chemical characteristics (with emphasis on the more mobile chemicals with higher toxicity), amount applied, application method, and proximity of the treatment to the tile area.

Streamflow monitoring as related to tile site 3 will be in the downstream station on Stream 2. This site will be used to determine the long-term downstream passage of pesticide concentrations found to flow from the upstream tile drains in native seedbeds. SPMDs will be used at this site to 'accumulate' transported pesticides. Tile drain concentrations will be compared to those collected in the SPMDs (see description in Cumulative Effects of Runoff discussion). This monitoring will provide information to determine wetland and channel effectiveness in attenuation of pesticides in runoff from the native seed operations.

Cumulative Concentrations Runoff Monitoring. SPMDs are proposed for deployment in Streams 9a (upstream and downstream), 2, and 5a to monitor the accumulation of pesticides in reaches containing aquatic species. The SPMD is an instream 'accumulator' which allows calculation of an average chemical concentration during the period of deployment.

Streamflow gauges (United States Geological Survey (USGS) and BLM) will be maintained in both Streams 2 and 9a to provide flow data for deriving concentrations (chemical loading) over the period of time the SPMD is deployed. Data from the SPMD concentrations will be used to compare and validate the storm flow concentration monitored during the deployment period. Since previous monitoring has detected no esfenvalerate at 0.02 ppb for all storm flow monitoring, the SPMDs will serve as an additional and potentially more accurate indicator of a 'low concentration' presence of the pesticide and provide documentation of exposure over time.

Monitoring Related to Modeled Concentrations. Validation monitoring is intended to verify the water quality modeling predictions used to develop the protective measures in the EIS. Rates of surface runoff and pesticide concentrations from high risk areas within Section 13 have been monitored and shown to be significantly lower than the literature and model predictions for the soils and climate at the orchard (BLM 2002). Although monitoring in Section 13 will continue, future validation monitoring will focus on developing similar information for Section 23.

Stream concentrations gathered at site 9c during effectiveness monitoring will be compared to Groundwater Loading Effects of Agricultural Management Systems (GLEAMS)[3] model results using actual application information, field-specific data, and continuous climate record. Once all potential surface runoff has occurred, the climate record collected during that period will be used to model a predicted concentration using the GLEAMS and Method of Characteristics (MOC)[4] models. These concentrations will be 'diluted' using the continuous flow data from the station. The resulting concentrations will be compared with the actual measured concentrations for each storm event sampled. Total losses will also be compared.

Concentrations well below those that will cause sublethal effects to fish were predicted for Stream 9a and the combination of Streams 2 and 5 in the RA. These stream systems will be monitored using SPMDs to determine the effectiveness of protective measures. These data will also help validate the conservative estimates in the RA.

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[3] The GLEAMS model, developed by the USDA Agricultural Research Service, is a computerized mathematical model developed for field-sized areas to evaluate the movement and degradation of chemicals within the plant root zone under various crop management systems. The model has been tested and validated using a variety of data on pesticide movement. A more detailed discussion of the GLEAMS model can be found in the Horning RA Sec 3-13.

[4] 'MOC' is a two-dimensional groundwater flow and chemical transport model, developed by the U.S. Geological Survey and is designed to account for the attenuating affect of buffer zones. and computes changes in concentration over time, accounting for the processes of dispersion, adsorption, and degradation.

As a partial continuation of past EA sampling, runoff samples of both water and sediment will be captured at the edge of field P-11 (flowing to Stream 5), which is the only field observed to have had overland flow since the initiation of water quality monitoring at the orchard. This site will be sampled during the first surface runoff event following application in the upslope watershed. Once the analysis results become available, the need to sample later runoff events will be determined based on concentrations detected. Concentrations will be compared with modeled results to assess the mobility of pesticides with high aquatic toxicity. In the future, this site is expected to receive only herbicide and fertilizer application and will be used to determine their associated mobility and design of protective measures

Compliance Monitoring.

Spill Monitoring. In the event of a chemical spill, the volume of spill, proximity to water, and chemical characteristics such as toxicity and mobility will be evaluated to determine if water sampling is desirable and necessary. If so, water samples will be collected in a sufficient number and at surface water and groundwater locations that will allow characterization of impacts and effective remediation methods. At a minimum, sampling will be conducted in the streams draining the spill area and the immediate groundwater table, if present. If in proximity to the spill, the orchard domestic well will also be sampled.

Groundwater Monitoring. The domestic well will be monitored according to the parameters outlined by the Oregon Department of Health. The well will be sampled for pesticides on a yearly basis during maximum well usage. The pesticides chosen for detection will vary according to the rates, persistence, and mobility of the pesticides applied during the period since the last sampling.

On select distribution lines in the greenhouse effluent field, groundwater monitoring wells have been installed to monitor continuous groundwater elevation and periodic water quality. Water quality sampling will be conducted when risks are highest for irrigation water to potentially reach the local ground water table. Highest risk occurs when mobile pesticides are being applied in the greenhouse, effluent is being irrigated, and the local groundwater table is less than 6 feet from the soil surface (indicating soils are at high moisture content). If these 'point in time' samples are found to have detectible levels of the pesticide, SPMDs will also be deployed in selected wells. These devices will allow a more quantitative determination of concentration over time. Groundwater elevation will be used to determine sampling period and irrigation timing. If a tank overflow event occurs, the distance of travel and estimated quantity will be recorded.

Annual Reporting. All water quality monitoring information associated with application of the Horning Seed Orchards IPM program will be compiled, analyzed, documented, and reviewed on a 'water year' basis. This 'water year' will include all monitoring performed during the October 1 to September 30 period. This information, along with any recommendation for adjustments to protection measures and adjustments to the monitoring plan, will be contained in an Annual Horning Monitoring Report. This report will be available to the public and regulatory agencies on November 15 of each year and be on file at Horning. BLM will request that NOAA

Fisheries' review of this Plan be complete by January 15 of the following year. This schedule will provide for timely inclusion of monitoring results in the Annual Operating Report and inclusion of the full period of runoff during the fall/winter period and planning for the upcoming budget year.

Framework for Multi-Year Consultation

In light of the dynamic nature of new scientific data, parallel section 7 consultations with EPA, and legal actions and decisions regarding pesticides summarized above, the BLM has included within the proposed action a methodology to facilitate multi-year consultation on the proposed project, as necessary, using the following process:

1. The BLM will submit an Annual Operation Report to NOAA Fisheries with the following information:
   a. A description of pesticide applications conducted over the reporting period.
   b. The results of the previous year monitoring program.
   c. A literature review of the pesticides that are proposed for use at Horning the following year. There may be a single review covering pesticides proposed at all four seed orchards. The review will include new scientific data regarding non-target fish species effects or environmental fate, changes to EPA-approved labels, and legal findings relevant to the use of the pesticides. Any new data will be considered in terms of effects on seed orchard use as proposed in the BA and on the conclusions of the EIS RA.
   d. A plan for proposed pesticide applications for the following year, including, units or acres to be treated, proposed pesticide, application rate and method, dates, and a proposed monitoring plan covering the locations and pesticides to be monitored. This plan will note that it may be possible for the seed orchard manager to schedule some applications, such as roadside vegetation management or insecticides for cone and seed insects in units that will be harvested to meet specific seed needs, in advance, and they will be fully described. However, the seed orchard manager will have the flexibility to use any of the applications as described in Table 3-1 of the BA, to respond to unforeseen pest management needs (for example, detection of disease or an insect infestation).
   e. Any proposed changes to the selected alternative as described in the EIS and Record of Decision (ROD), including new limitations, protection measures, or mitigation measures as part of an adaptive management approach; the use of pesticides in addition to those listed in Table 3-1; or other relevant information.

2. A new BA providing an updated effects analysis will be submitted to NOAA Fisheries with the annual Operation Report if the literature review:
   a. Identifies new scientific data or labeling details indicating additional possible effects to listed species.
   b. Identifies proposed changes to the selected alternative as described in the EIS and ROD.

c. Determines that monitoring data following pesticide applications indicate that effects are greater than anticipated.

Approach to Finding New Information on Pesticides Proposed for Use at Horning. Before the analysis phase begins, the BLM will identify the relevant technical literature for the pesticide or pesticides in question. The ESA requires that Federal agencies use the best scientific and commercial data available (50 C.F.R. 402. 14[d]). This section provides an overview of search and acquisition strategies that can be used to identify peer-reviewed data and other forms of scientific evidence that may be relevant to Pacific salmon and steelhead.

Online Scientific Databases. The literature search for each active ingredient, as well as inert ingredients, adjuvants, surfactants and degradates will include keyword-based queries of several scientific databases. In addition to EPA's ECOTOX database, the targeted databases will include Aquatic Sciences and Fisheries Abstracts, Medline, Web of Science, AGRICOLA, Chem Abstracts, and BIOSIS. The searches will also be supplemented with literature abstracting databases including Toxline, Toxnet, and Current Contents: Agriculture, Biology, and Environmental Sciences.

Keywords. Scientific databases will be searched with keywords that are specific to fish or known invertebrate prey species for salmon or steelhead.[5]

Paper-Based Searches. Paper-based searches of bibliographies, guidance documents, modeling studies, and review articles will be conducted to identify primary sources of relevant scientific information. In addition, data provided in support of pesticide registrations will be considered.

Other Actions Not Covered Under the BA. Herbicide use for competing vegetation (non-noxious applications) are not covered in this Opinion.

Action Area

'Action area' means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 C.F.R. 402.02). For purposes of this consultation, the action area for this consultation includes streams in the Section 13 portion of the orchard, Swagger Creek, Clear Creek, and the lower Clackamas River to its confluence with the Willamette River. In addition, the action area includes streams in the Section 23 portion of the orchard and Milk Creek to its confluence with the Molalla River. At which point, any

[5] For fish, all keywords, or an appropriate subset, will include *salmonid, Chinook salmon, coho salmon, steelhead salmon, chum salmon, sockeye salmon, pink salmon, Atlantic salmon, cutthroat trout, bull trout, rainbow trout, char, Oncorhynchus mykiss, O. tshawytcha, O. kisutch, O. nerka, O. gorbuscha, O. clarkii, Salmo, Salvelinus, alevin, fry, parr, smolt, and fish.* For potential impacts to invertebrate prey species, all keywords, or an appropriate subset, will include *chironomid, mayfly, stonefly, copepod, amphipod, mysid, cladoceran, Chironimidae, Simuliidae, Ephemeroptera, Plecoptera, Neoptera, Trichoptera, Copepoda, Diptera, Gammaridae, Daphnia.* For potential impacts on primary production in aquatic systems, all keywords, or an appropriate subset, will include *algae, diatom, periphyton, Chlorella, and Selenastrum.* Additional keywords may be used as appropriate. For each pesticide, the active ingredient, inert ingredient(s), adjuvant, surfactant, degradate(s), product name(s), and Chemical Abstract Registry Number (CAS RN) will be used in the database search.

waterborne contaminant concentrations resulting from the delivery of pesticides will be diluted to a negligible level.

The action area is used by UWR and LCR steelhead, UWR and LCR Chinook salmon, and LCR coho salmon for all life history stages. The project area is also designated as EFH for Pacific Coast salmon (PFMC 1999), or is in an area where environmental effects of the proposed project may adversely affect designated EFH for those species.

ENDANGERED SPECIES ACT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with U.S. Fish and Wildlife Service and NOAA Fisheries, as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitats.
Section 9(a)(1) and protective regulations adopted pursuant to section 4(d) of the ESA prohibit the 'taking' of listed species without a specific permit or exemption. Among other things, an action that harasses, wounds, or kills an individual of a listed species or harms a species by altering habitat in a way that significantly impairs its essential behavioral patterns is a taking (50 C.F.R. 222.102). 'Incidental take' refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 C.F.R. 402.02). Section 7(o)(2) exempts any taking that meets the terms and conditions of a written incidental take statement from the taking prohibition.

Biological and Conference Opinion

This Opinion presents NOAA Fisheries' review of the status of each evolutionarily significant unit (ESU)[6] considered in this consultation and critical habitat, the environmental baseline for the action area, all the effects of the action as proposed, and cumulative effects. An analysis of those combined factors is used to conclude whether the proposed action is likely to appreciably reduce the likelihood of both the survival and recovery of the affected ESUs, or is likely to destroy or adversely modify designated critical habitat (50 C.F.R. 402.14(g)). If the action under consultation is likely to jeopardize an ESU, or destroy or adversely modify designated critical habitat, NOAA Fisheries must identify any reasonable and prudent alternatives for the action that avoid jeopardy or destruction or adverse modification of critical habitat and meet other regulatory requirements (50 C.F.R. 402.02).

[6] 'ESU' means an anadromous salmon or steelhead population that is either listed or being considered for listing under the ESA, is substantially isolated reproductively from conspecific populations, and represents an important component of the evolutionary legacy of the species (Waples 1991). An ESU may include portions or combinations of populations more commonly defined as stocks within or across regions.

Status of the ESUs

This section defines range-wide biological requirements of each ESU, and reviews the status of the ESUs relative to those requirements. Refer to table 5 for listing status of species considered in this Opinion. The present risk faced by each ESU informs NOAA Fisheries' determination as to whether additional risk would 'appreciably reduce' the likelihood of both survival and recovery in the wild. The greater the present risk, the more likely any additional risk resulting from the proposed action's effects on the population size, trend (growth rate), distribution, and genetic diversity of the listed species would be an appreciable reduction (McElhaney *et al.* 2000).

Table 5. Listing status of species considered in this Opinion

Species	Listing Status	Critical habitat	Protective Regulations	Biological Information/ Population Trends
LCR Chinook salmon	Threatened 03/24/99 64 FR 14308	Not Designated	07/10/00 65 FR 42422	Myers *et al.* 1998; Healey 1991; ODFW and WDFW 1998
UWR Chinook salmon	Threatened 03/24/99 64 FR 14308	Not Designated	07/10/00 65 FR 42422	Myers *et al.* 1998; Healey 1991; ODFW and WDFW 1998
LCR steelhead	Threatened 03/19/98 63 FR 13347	Not Designated	07/10/00 65 FR 42422	Busby *et al.* 1995; Busby *et al.* 1996; ODFW and WDFW 1998
UWR steelhead	Threatened 03/25/99 64 FR 14517	Not Designated	07/10/00 65 FR 42422	Busby *et al.* 1995; Busby *et al.* 1996; ODFW and WDFW 1998
LCR coho	Proposed 06/14/2004	NA	NA	

General Steelhead Life History

Steelhead are rainbow trout that migrate to the ocean. Two races of steelhead are found: Summer and winter steelhead. Summer steelhead are usually associated with larger rivers that have adequate summer flows to accommodate summer upstream migration and deep resting pools with cooler water. Summer steelhead are generally found in rivers with spring-run Chinook populations. Summer steelhead tend to spawn in very small, intermittent tributaries and winter steelhead tend to spawn in medium-sized to large streams. Steelhead exhibit a wide variety of migration and freshwater rearing strategies, and spawn from mid-winter to late spring. Summer steelhead fry tend to emerge earlier in the late winter/early spring than winter steelhead fry. Historic steelhead habitat is extremely variable, as these fish are adept at migrating through steep gradient stream segments and over waterfalls of moderate height. Steelhead fry and parr can be found in very steep mountain stream habitats and in interior and coastal unconstrained valley streams.

Generally, steelhead remain in freshwater for 1 to 3 years, and the ocean phase varies from 1 to 3 years. Steelhead are iteroparous and can return to spawn more than once. Ocean migration is highly variable for steelhead, generally following the north and south migration strategies of coho salmon and Chinook salmon. Steelhead are less gregarious than salmon in their ocean phase, and individuals can range as far as the Aleutian Islands.

Upper Willamette River (UWR) steelhead. The UWR steelhead ESU occupies the Willamette River and tributaries upstream of Willamette Falls, extending to, and including, the Calapooia River. These major river basins containing spawning and rearing habitat comprise more than 12,000 km^2 in Oregon. Rivers that contain naturally-spawning, winter-run steelhead include the Tualatin, Molalla, Santiam, Calapooia, Yamhill, Rickreall, Luckiamute, and Mary's Rivers. Early migrating winter and summer steelhead have been introduced into the Upper Willamette Basin, but those components are not part of the ESU. Willamette Falls (river mile (RM) 26) is a known migration barrier and while winter steelhead and spring Chinook salmon historically occurred above the falls, summer steelhead, fall Chinook, and coho salmon did not. Native winter steelhead within this ESU have been declining since 1971, and have exhibited large fluctuations in abundance. Habitat in this ESU has become substantially simplified since the 1800's by removal of large woody debris to increase the river's navigability, by reduction in riparian vegetation, and by channel modifications.

In general, native steelhead of the Upper Willamette Basin are primarily late-migrating winter steelhead, entering freshwater primarily in March and April. This atypical run timing appears to be an adaptation for ascending Willamette Falls, which functions as an isolating mechanism for UWR steelhead. Reproductive isolation resulting from the falls may explain the genetic distinction between steelhead from the Upper Willamette Basin and those in the lower river. UWR late-migrating steelhead are ocean-maturing fish. Most return at age four, with a small proportion returning as 5-year-olds (Busby *et al.* 1996).

Spawning takes place from April through the first of June, similar to historical conditions. Because spawning takes place primarily in May, it is separated in time from that of UWR Chinook salmon which takes place primarily in September. Some spatial separation also occurs because UWR steelhead typically spawn in smaller streams than UWR Chinook salmon.

The West Coast steelhead Biological Review Teams (BRT) met in January, 2003, to determine if new information or data warranted any modification of the conclusions of the original BRTs. They focused primarily on information for anadromous populations in the RAs for steelhead ESUs, but considered the presence of relatively numerous, native resident fish as a mitigating risk factor for some ESUs. Their draft report noted that after a decade in which Willamette Falls counts were near the lowest levels on record, adult returns for 2001 and 2002 were up significantly. Yet the total abundance is small for the entire ESU with a recent mean of less than 6,000, with many populations at relatively low levels. Most of the populations are in decline over the period of the available time series (NOAA Fisheries 2003). Given that the BRT could not conclusively identify a single naturally self-sustaining population, it is uncertain whether recent increases can be sustained. The discontinuation of the releases of the 'early' winter-run

hatchery population was described as positive, but continued releases of non-native summer steelhead are a cause for concern. Available time series are confounded by the presence of hatchery-origin spawners.

For the UWR steelhead ESU as a whole, NOAA Fisheries estimated that the median population growth rate (lambda) over the base period ranges as 0.93 (McClure *et al.* 2000). For the Mollala River steelhead population, which includes fish within Milk Creek, lambda was estimated to be 0.87.

There is no habitat for UWR steelhead within Horning. Streams in the Section 23 portion of Horning flow into Nate Creek, a tributary to Milk Creek, which flows into the Molalla River. This section of the seed orchard is bisected by the headwater segment (Stream 9a) of Nate Creek. UWR steelhead trout are native to Milk Creek and are present approximately 5 miles downstream from Horning at the confluence with Nate Creek (ODFW 2002, as referenced in BLM 2004). There are no records indicating that steelhead utilize Nate Creek, though accessible habitat is appropriate for their use. Although steelhead are found in Milk Creek to the southeast of the orchard, there are no surface flowing tributaries that connect the orchard to this part of Milk Creek.

The native winter steelhead pass over Willamette Falls between mid-February and mid-May. Most of these fish are headed for the Santiam River system. The run size of native steelhead to the combined Molalla and Pudding rivers during 1976-1977 to 1988-1989 ranged from about 2,000 to 5,000 fish. Approximately 2.5% of the steelhead redds counted in the Molalla/Pudding Basin are found in Milk Creek (1985-1991).

Nate Creek, the Milk Creek tributary that flows from Section 23 of the orchard, is not known to be used by steelhead for either spawning or rearing. The nearest steelhead rearing habitat from the orchard is at the confluence of Nate Creek with Milk Creek, about five miles from the orchard.

Lower Columbia River (LCR) steelhead. The LCR steelhead ESU encompasses all steelhead runs in tributaries between the Cowlitz and Wind Rivers on the Washington side of the Columbia River, and the Willamette and Hood Rivers on the Oregon side. The major runs in this ESU, for which there are estimates of run size, are the Cowlitz River winter runs, Toutle River winter runs, Kalama River winter and summer runs, Lewis River winter and summer runs, Washougal River winter and summer runs, Wind River summer runs, Clackamas River winter and summer runs, Sandy River winter and summer runs, and Hood River winter and summer runs.

Steelhead in this ESU are thought to use estuarine habitats extensively during out-migration, smoltification, and spawning migrations. The lower reaches of the Columbia River are highly modified by urbanization and dredging for navigation. The upland areas covered by this ESU are extensively logged, affecting water quality in the smaller streams used primarily by summer runs. In addition, all major tributaries used by LCR steelhead have some form of hydraulic

barrier that impedes fish passage. Barriers range from the impassible structures in the Sandy Basin operated by the Portland Water Bureau that block access to extensive, historically occupied steelhead habitat, to the passable but disruptive projects on the Cowlitz and Lewis Rivers.

For the LCR steelhead ESU as a whole, NOAA Fisheries estimated that the median population growth rate (lambda) over the base period ranges as 0.96 (McClure *et al.* 2000). For the Clackamas River winter steelhead population, which includes fish within Clear Creek, lambda was estimated at 0.91.

There is no habitat for LCR steelhead within Horning. Streams in the Section 13 portion of Horning flow into Swagger Creek, a tributary to Clear Creek, which flows into the Clackamas River. Clear Creek Watershed has habitat conditions appropriate for LCR steelhead spawning and rearing and steelhead from the LCR ESU are present in Clear Creek in the vicinity of its confluence with Swagger Creek, approximately one mile downstream from Horning (ODFW 2002 as referenced in BLM 2004). Upstream migration of steelhead in Clear Creek is blocked by barrier falls on both forks just above the confluence of Clear Creek and the north fork of Clear Creek, approximately two miles above the Swagger Creek confluence. It is not known if steelhead use Swagger Creek, but the very lower portion of Swagger Creek appears to be accessible, though Swagger Creek is not identified as steelhead habitat by ODFW. There appears to be a topographic barrier to upstream fish movement on Swagger Creek about 0.5 miles above the confluence with Clear Creek, on private land. Based on a USGS topographic map, the elevation change is approximately 300 feet within less than 1/4 mile.

The timing of habitat use from UWR and LCR steelhead is summarized in Table 6.

Table 6. Steelhead habitat presence in Clear Creek and Milk Creek. Shaded months indicate particular lifestage use.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adult Immigration/ Holding												
Adult Spawning												
Incubation/ Emergence												
Juvenile Rearing												
Juvenile emigration												

General Coho Salmon Life History

Coho salmon typically begin to mature during the summer after one winter at sea, and arrive at their rivers of origin during late summer and autumn. Spawning can occur between late September through January, with emergence occurring from 50 to 120 days later.

Most juvenile coho spend at least 1 year in fresh water before emigrating to estuary and ocean environments, though some juveniles may stay in fresh water for 2 or 3 years. The proportions of freshwater residency are generally highly variable (Groot and Margolis 1991).

Lower Columbia River (LCR) coho salmon. Coho salmon are a widespread species of Pacific salmon, occurring in most major river basins around the Pacific Rim (NOAA Fisheries 2003). Coho smolts typically leave freshwater (after a year or more) in the spring (April to June) and re-enter freshwater when sexually mature from September to November, and spawn from November to December and occasionally into January (Sandercock 1991). Stocks from the Columbia River often have very early (entering rivers in July or August) or late (spawning into March) runs in addition to 'normally' timed runs.

In NOAA Fisheries' 1991 status review of LCR coho, the BRT limited the geographic scope of its review to the subject of the motivating listing petition: the LCR excluding the Willamette River. The 1991 BRT concluded that historical LCR coho populations were probably reproductively isolated from other coho populations, but the BRT was unable to identify whether a historical coho ESU still existed in the LCR. In the 1995 status review of West Coast coho salmon, the BRT considered new information suggesting that LCR coho may be part of a larger ESU, based on similarities in physical and biogeographical conditions, and preliminary genetic data. The 1995 BRT included LCR coho as part of a larger Southwestern Washington (SWW)/LCR coho ESU, and NOAA Fisheries designated the SWW/LCR coho ESU as a candidate species (60 FR 38011; July 25, 1995). In 1996, NOAA Fisheries' West Coast Coho Salmon BRT updated the 1995 status review, and concluded that the SWW/LCR ESU may warrant splitting into separate SWW and LCR ESUs.

In 2001 the BRT reconvened to update information on the viability of LCR coho and concluded that LCR coho is a separate ESU from SWW coho. This conclusion was supported by new tagging data and analyses indicating that SWW and LCR coho populations have differing marine distributions and are genetically distinct. This finding is consistent with the stock structure exhibited by LCR Chinook and steelhead populations (Myers *et al.*, 2003). The 2001 BRT also concluded that the historical ESU still exists in the LCR. The primary evidence to support this conclusion is the consistent genetic and life history differences between LCR coho salmon and populations from other areas. The BRT concluded that, because of presumably very low survival rates, stock transfers from Oregon coastal populations 40 to 80 years ago probably had relatively little permanent effect on the genetic makeup of LCR coho salmon. Nevertheless, the BRT recognized that the ESU as it presently exists is much altered from historical conditions, and evidence of appreciable natural production is limited to two Oregon populations (in the

Sandy and Clackamas Rivers) that represent the clearest link (through more or less continuous natural production) to historical populations within the ESU.

Based on available information, most of the adult coho salmon returning to natural or hatchery areas outside these two streams appear to have themselves been reared as juveniles in hatcheries, or to have had parents that were reared in hatcheries. The 2001 BRT concluded that collectively, these hatchery-produced fish contain a significant portion of the historical diversity of LCR coho salmon, albeit in somewhat altered form. In determining the upstream boundary of the LCR coho ESU, the 2001 BRT concluded that Upper Columbia River coho (now extinct) were likely not part of the LCR coho ESU, and that the Cascade Crest represents the most likely eastern terminus of the LCR coho ESU. The 2003 Pacific Salmonid BRT did not revisit the 2001 ESU boundaries for the LCR coho ESU.

Based on the foregoing, NOAA Fisheries concludes that the LCR coho ESU includes all naturally-spawned populations of coho salmon in the Columbia River and its tributaries, from the mouth of the Columbia up to and including the Big White Salmon and Hood Rivers.

The BRT concluded that some of the historical runs are now extirpated and that the Sandy River and Clackamas River populations are the only two populations with any significant production and that both are at appreciable risk due to low abundance, declining trends and failure to respond after significant harvest reductions (NOAA Fisheries 2003).

LCR coho have been documented to use Milk Creek, and its tributary Nate Creek, as close as two miles below the Orchard.

Timing of adult coho salmon river entry is largely influenced by river flow. Coho salmon normally wait for freshets before entering rivers. In the Molalla and Clackamas Watersheds, adults are believed to typically enter the river between October and March, with peak migration occurring in later portions of this period. Similarly, peak spawning generally occurs in mid to late winter. Intragravel residency (egg to fry) varies greatly between basins and reaches, and is largely dependent on substrate composition and water temperature (Groot and Margolis 1991). No specific information is available on intragravel residence timing in these basins. However, incubation can last around 110 days, with emergence typically occurring two to three weeks following hatch (Groot and Margolis 1991). This suggests a four- to five-month intragravel residency period. Seaward migration of juveniles occurs during the spring. The timing of habitat use for Coho salmon is summarized in Table 7.

Table 7. Coho salmon use in streams within the action area

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Adult Immigration/ Holding												
Adult Spawning												
Incubation/ Emergence												
Juvenile Rearing												
Juvenile emigration												

General Chinook Salmon Life History

Chinook salmon in streams and rivers are generally divided into two races: Spring- and fall-run. Spring-run Chinook enter freshwater from April though June, and are usually associated with larger rivers and streams that have adequate summer flows and deep resting pools for adults during the summer. Fall-run Chinook enter freshwater from September through December and use many of the medium-sized and larger streams with access from the ocean through low gradient stream habitat. Their annual spawning distribution in smaller streams is dependent on the amount of fall rains and resultant streamflow.

Spring-run Chinook spawn in the early fall, earlier than fall-run Chinook in most rivers. Fall-run Chinook spawn from early fall to mid-winter. Chinook fry emerge in late winter to early spring and typically begin a downstream migration to the river estuary or the ocean. Variations from this pattern occur in all populations, with some fry remaining in freshwater for a year. Chinook salmon fry and parr generally rear in larger streams and rivers. The typical life cycle for Chinook salmon is to spend a few months in freshwater and from two to five years in saltwater and thus they are ocean-rearing. Many variations occur in the freshwater rearing timing, and precocious males return from the ocean a year or two early as jacks.

<u>**Lower Columbia River (LCR) Chinook salmon.**</u> LCR Chinook migrate through, and rear in, the lower Clackamas River in the action area. The lower Columbia River is characterized by numerous short- and medium-length rivers that drain the coast ranges and the west slopes of the Cascade Mountains. The LCR Chinook salmon ESU includes all native populations from the mouth of the Columbia River to the crest of the Cascade Range, excluding populations above Willamette Falls.

Most fall-run fish in the LCR Chinook salmon ESU emigrate to the marine environment as subyearlings. Timber harvest and road activities continue to be of concern for this ESU. Agriculture is widespread within this ESU and has affected riparian vegetation and stream hydrology. The ESU is also highly affected by urbanization, including river diking and channelization, wetland draining and filling, and pollution.

For the LCR Chinook ESU as a whole, NOAA Fisheries estimated that the median population growth rate (lambda) over the base period ranges as 0.99 (McClure *et al.* 2000). Lambda for Clackamas River Fall Chinook was estimated to be 0.96.

Upper Willamette River (UWR) spring Chinook salmon. UWR spring Chinook salmon migrate through, and rear in, the lower Clackamas River in the action area. The Clackamas River spring and fall Chinook populations were each designated as 'core'[7] populations by the Willamette/Lower Columbia Technical Recovery Team (NOAA Fisheries 2002). UWR spring Chinook salmon also migrate, spawn, and rear in lower Milk Creek (within the Molalla Basin). UWR Chinook also use Clear Creek. The UWR Chinook salmon ESU includes native spring-run populations above Willamette Falls and in the Clackamas River.

Fish in this ESU are distinct from those of adjacent ESUs in life history and marine distribution. The life history of Chinook salmon in the UWR ESU includes traits from both ocean- and stream-type development strategies. The total run sizes reported for UWR spring Chinook since 1970 have ranged from 30,000 to 130,000, with the 2000-2002 runs in the range of 60,000 to 120,000.

In 2003, the BRT found that, except for the Clackamas population, spring Chinook in this ESU must pass Willamette Falls, when migrating to or from spawning areas. The BRT reviewed data of historical spring Chinook populations including: Clackamas, Mollala, North Santiam, South Santiam, Calapooia, McKenzie, and Middle Fork Willamette Rivers. While lacking an assessment of the ratio of hatchery-origin to wild-origin Chinook passing the falls, hatchery-origin fish were described as dominating the runs.

For the UWR Chinook ESU as a whole, NOAA Fisheries estimated that the median population growth rate (lambda) over the base period ranges as 0.99 (McClure *et al.* 2000).

The timing of habitat use from UWR and LCR Chinook is summarized in Table 8 below. Both spring and fall Chinook use the lower Clackamas River, and Clear Creek. Spring Chinook utilize the lower portion of Milk Creek, as well as the Molalla River.[8]

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[7] Core populations have been designated by the TRT so '...recovery agencies consider giving priority to these core populations in developing their recovery plans. In addition to sustaining the evolutionary legacy of the ESU, these core populations may offer the most likely path to recovery.'

[8] Personal Communication between Dan Tonnes (NOAA Fisheries) and Bob Ruediger (BLM) on May 2, 2004.

Table 8. Spring Chinook habitat presence in Milk Creek, the Molalla River, Clear Creek, and the lower Clackamas River. Shaded months indicate particular lifestage use.

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Adult Immigration/ Holding												
Adult Spawning												
Incubation/ Emergence												
Juvenile Rearing												
Juvenile emigration												

Environmental Baseline

The 'environmental baseline' includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 C.F.R. 402.02). For projects that are ongoing actions, the effects of all past actions are part of the environmental baseline and the effects of future actions over which the Federal agency has discretionary involvement or control will be analyzed as 'effects of the action.'

Analysis of the environmental baseline is guided by the specific habitat components necessary to support salmon and steelhead within the action area. When the environmental baseline departs from conditions that support those biological requirements, it becomes more likely that additional risk to the ESU resulting from the effects of the proposed action on the ESU or its habitat will result in jeopardy (NMFS 1999). The biological requirements of salmon and steelhead in the action area vary depending on the life history stage present and the natural range of variation present within that system (Groot and Margolis 1991; Spence *et al.* 1996).

Generally during spawning migrations, adult salmon require clean water with cool temperatures or thermal refugia, dissolved oxygen near 100%, low turbidity, adequate flows and depths to allow passage over barriers to reach spawning sites, and sufficient holding and resting sites. Spawning areas are selected based on species-specific requirements of flow, water quality, substrate size, and groundwater upwelling. Embryo survival and fry emergence depend on substrate conditions (*i.e.*, gravel size, porosity, permeability, and oxygen levels), substrate

stability during high flows, and, for most species, water temperatures of 13˚C or less. Habitat requirements for juvenile rearing include seasonally suitable microhabitats for holding, feeding, and resting. Migration of juveniles to rearing areas, whether the ocean, lakes, or other stream reaches, requires unobstructed access to these habitats. Physical, chemical, and thermal conditions may all impede migrations of adult or juvenile fish.

The ESUs considered in this Opinion resides in or migrates through the action areas. Thus, for this action area, the biological requirements for salmon and steelhead are the habitat characteristics that would support successful migration, spawning, incubation, rearing and emigration.

Horning is on the upland watershed divide between the lower Clackamas River 5th field watershed and the Milk Creek 5th field watershed, northeast of Colton, Oregon. In this topographic position, the orchard serves as headwater areas for a number of small streams within its boundaries. Horning's upland location is divided into two separate zones: one in Section 13 and one in Section 23, both in Township 4 South, Range 3 East. Streams in the Section 13 portion of Horning flow into Swagger Creek, a tributary to Clear Creek that flows into the Clackamas River. Streams in the Section 23 portion flow into Nate Creek, a tributary to Milk Creek that flows into the Molalla River.

Section 303(d) of the Clean Water Act requires states to list impaired waterbodies. The list identifies those waterbodies that do not meet all applicable water quality standards necessary to protect beneficial uses. The 1998 Oregon Department of Environmental Quality (ODEQ) 303(d) list includes the Molalla River at its confluence with Milk Creek as water quality limited due to bacteria and temperature (approximately 19 miles below the orchard boundary); the draft 2002 303(d) list includes flow modification with the qualifier that a Total Maximum Daily Load (TMDL) was not needed (ODEQ 2002). The Clackamas River and its confluence with Clear Creek (approximately 17 miles below the orchard boundary) are listed as water quality limited for temperature (1998) and bacteria (ODEQ 2002).

The BLM assessed parameters using NOAA Fisheries' matrix of pathways and indicators (MPI) for several baseline conditions in both the Upper Clear Creek and Milk Creek Watersheds. The MPI method assesses the current condition of instream, riparian, and watershed factors that collectively provide for a properly functioning aquatic habitat, essential for maintaining salmonid populations. Environmental baselines are categorized as either 'properly functioning,' 'at risk,' or 'not properly functioning.' A summary of the evaluation for each watershed is provided below.

Clear Creek and the Lower Clackamas River. The only factor in which the IPM program is likely to affect baseline conditions in Clear Creek is water quality (chemical contamination/nutrients). Other factors that are categorized as properly functioning include access to streams for anadromous fish and stable bank conditions. At-risk factors include high water temperature, lack of refugia, and the peak to base flows. Factors identified as not properly functioning include a passage barrier to resident fish, lack of large woody debris, and increased

drainage from roads, road density and location, disturbance history, and fragmented riparian reserves. The USGS reported land-use distribution within the 72 (mi^2) watershed as urban-4%, agricultural-8%, mature forest-22%, non-forest upland-18%, and regrowth forest-45% (USGS 2003). Temperatures within Clear Creek have been measured as high as 20.7 °C in August (USGS 2003). The USGS detected concentrations of atrazine during storm runoff events in May and October 2000 within the Clear Creek Watershed. Other herbicides, deethylatrazine, along with pendimethalin and triclopyr were also detected. Clear Creek contributed 4% of the lower Clackamas River pesticide load in May 2000, and 2% in October 2000 (USGS 2003).

Environmental baseline conditions within the lower Clackamas River were evaluated in 2003 by the Federal Energy Regulatory Commission (FERC).[9] For the lower Clackamas River, three of the 17 indicators evaluated were rated by FERC as properly functioning. These were sediment/turbidity, physical barriers, and substrate. Ten indicators were rated as functioning at risk. These were chemical contamination/nutrients, off-channel habitat, refugia, width/depth ratio, floodplain connectivity, change in peak/base flow, drainage network increase, road density and location, disturbance history, and riparian reserves. The water temperature large woody material, pool frequency/quality, and streambank condition indicators were rated not properly functioning. The Clackamas River from its mouth to RM 15 is listed on the ODEQ 303(d) list as water quality limited for summer water temperature and impaired for E. coli bacteria.

A 2000-2001 study conducted by the U.S. Geological Survey and Clackamas County within the lower Clackamas River detected 27 pesticides, including 18 herbicides, seven insecticides, and two pesticide breakdown products in 18 stream samples within the lower river. Within all of the sampling, pesticides were always detected with at least one other pesticide. Within half of the sampling, six or more pesticides were detected at the same time (USGS 2003). Clear Creek was only sampled at the terminus with the Clackamas, though the likely sources of these pesticides are similar land-uses to those near Horning: commercial forest, agriculture, and suburban housing. Regarding the possible sources, the report stated:

> Identification of pesticides sources in the Clackamas River Basin is difficult because of the diverse land uses in the basin and the multiple-use nature of many of the pesticides detected. Of the 25 parent pesticides detected, 22 have agricultural uses, 24 have urban uses, 16 are applied to golf courses, 11 are applied along roads and other right-of ways, and 5 have or had forestry applications. Based on current available crop acreages for Clackamas County and best estimates of chemical application rates in the Pacific Northwest, most (49%) of the pesticide estimated to be applied to agricultural lands in Clackamas County (for those detected) is used for nursery and greenhouse crops. Lesser amounts, ranging from 4 to 15%, are applied to pastureland, Christmas trees, alfalfa and hay fields, hazlenuts, and grass seed fields. Also, because only a small fraction of the thousands of pesticide products registered for use in Oregon were tested for during this

[9] This document can be viewed at http://www.nwr.noaa.gov/1publcat/bo/2003/200300409_northwest_pipeline_07-30-2003.pdf

study, pesticide use information would help ensure that high-use pesticides are included in further studies (USGS 2003).

Milk Creek and Molalla River Watersheds. The lower Molalla River Watershed is listed on the ODEQ's 303(d) list as being severely impacted for several water quality parameters, including dissolved oxygen and bacteria levels. Most of the lower elevation areas of the Milk Creek watershed are dominated by agricultural land, several small urban areas, and numerous rural residences which may produce nonpoint discharges of sediment and turbidity in this area of the lower Molalla River. Currently, no factors in Milk Creek are regarded as properly functioning. Water quality in Milk Creek is currently determined to be at risk due to heavy sedimentation/turbidity and chemical contamination/nutrients. Factors also categorized as at risk include lack of off-channel habitat and refugia, drainage networks, road density and location, disturbance history, and physical barriers. A potential lack of large woody debris and fragmented riparian reserves led these factors to be regarded as not functioning properly. The BLM found that other conditions had insufficient or no data on which to base an evaluation.

The Molalla Basin has generally elevated temperatures. The 1997 mid-August seven-day maximum average was almost 24°C (at RM 27) (BLM and USFS 1999). Around two-thirds of the land ownership within the basin private timber and agriculture, with the rest within state and Federal land ownership (BLM and USFS 1999).

The BLM summarizes water quality within the Molalla River with the following:

> The Molalla River at Canby experiences elevated levels of total phosphates, nitrate and ammonia nitrogen, fecal coliform, and biochemical oxygen demand in the fall, winter, and spring. High temperature, high biochemical oxygen demand, and low dissolved oxygen concentrations are evident in the low flow summer months. This is the result of non-point source pollution in the low-lying agricultural areas along the lower half of the river. These impacts appear to have increased over time, as water quality significantly declined during the reporting period (BLM 2004).

Horning Orchard. Positioned on the watershed divide between the Clackamas River and Molalla River Basins, the Horning Orchard serves as the headwaters for a number of small streams within its boundaries. Streams in the Section 13 portion of the orchard flow into Swagger Creek, a tributary to Clear Creek, which in turn flows into the Clackamas River. Streams in the Section 23 portion flow into Nate Creek, a tributary to Milk Creek, or directly into Milk Creek, which in turn flows into the Molalla River. Within these watersheds, higher flows and precipitation occur between November and April, and a reduction in storm flows after the month of May. Most of the streams that drain the area are either ephemeral/intermittent. Ephemeral streams generally flow in direct response to storm events while the intermittent streams flow during the late fall, winter, and spring periods of higher precipitation. There is one larger perennial stream that bisects the Section 13 portion of the seed orchard, and several smaller perennial streams. The extent of historic ephemeral channels and their associated wet

areas have been reduced in the past through the installation of subsurface drainage ('tiling') to drain the land and thus increase the area available for tree production.

In Section 23, Stream 8 is ephemeral north of Unger Road, and when it flows, it goes underground before reaching the road. Flow resurfaces near the BLM property line. There is no direct surface connection between Streams 8d and 8e and Milk Creek. Maps illustrating the orchard's water resources in Sections 13 and 23, including a number for each stream segment, are presented in Attachment A of the BA. Table 9 below contains hydrologic and riparian information for these streams.

Table 9. Horning stream characteristics

Stream Number	Duration of Flow	Type of Flow	Riparian Vegetation Type
8b, 8d, 8e, 9e, 9g, 9h	During and for short periods after winter storms	ephemeral	Mature conifer and hardwood; well-developed understory
5c	During and for short periods after winter storms	ephemeral	Scattered hardwood and shrub; breaks in overstory
10, 11c	During and for short periods after winter storms	ephemeral	Grass, minor overstory
5b, 6c, 6d, 6e, 6f, 6g, 6h, 6i, 7a, 7b, 8a, 8c, 9b, 9d, 9f	Estimated to flow from November through April in most years	intermittent	Mature conifer and hardwood; well-developed understory
11b	Estimated to flow from November through April in most years	intermittent	Scattered hardwood and shrub
1,2, 5a, 9c, 11a	all year	perennial	Mature conifer; hardwood understory
6a	all year	perennial	Mature conifer; hardwood understory
6b	all year	perennial	Mature conifer; hardwood understory; many beaver dams
9a	all year	perennial	Mature conifer; hardwood understory

Land uses neighboring the Horning Orchard include small farms, timber operations, Christmas tree farms, livestock grazing, rural residences, and an organic farm. These type of land uses near the seed orchard may use many of the same chemicals as BLM proposes to use, however, the BLM could not determine which chemicals may be used, or the extent to which chemicals may be used in the Clear Creek and Milk Creek Subwatersheds. Christmas tree farmers adjacent to the orchard, aerially apply pesticides to their fields to reduce unwanted competitive vegetation. However, the products used are not known. There is a reasonable deduction that these type of

land uses may incorporate pesticides into their land management, though the timing, quantities, and frequency of applications of pesticides are unknown at this time.

Horning produces seed of Douglas-fir, western hemlock, western red cedar, western white pine, and sugar pine. Managed stands of these species are scattered in small, even-aged patches throughout the seed orchard. These areas were cleared or tilled of native vegetation and replanted with the desired species. The understory in these areas is dominated by grasses with some areas of forbs.

Soils. Four types of soil are present at Horning: Cottrell silty clay loam, Jory silty clay loam, Klickitat stony loam, and Springwater loam (Soil Conservation Service 1985, as referenced in BLM 2004). The cation exchange capacity of each of these soils (except for the Klickitat series, for which it is undetermined) is in the range of 10 to 25 milliequivalents per 100 grams, indicating that they contain smectite clay and a moderate amount of organic matter, which adsorbs pesticides and fertilizers and retards their movement through soil. The Oregon State University Extension Service (OSUES) developed soil sensitivity ratings for groundwater contamination based on leaching characteristics (permeability, soil depth, depth to groundwater, annual precipitation, and runoff as compared to infiltration) and sorption potential (the amount of organic matter and the cation exchange capacity) (OSUES 1998, as referenced in BLM 2004). Table 10 summarizes soil types and characteristics at Horning.

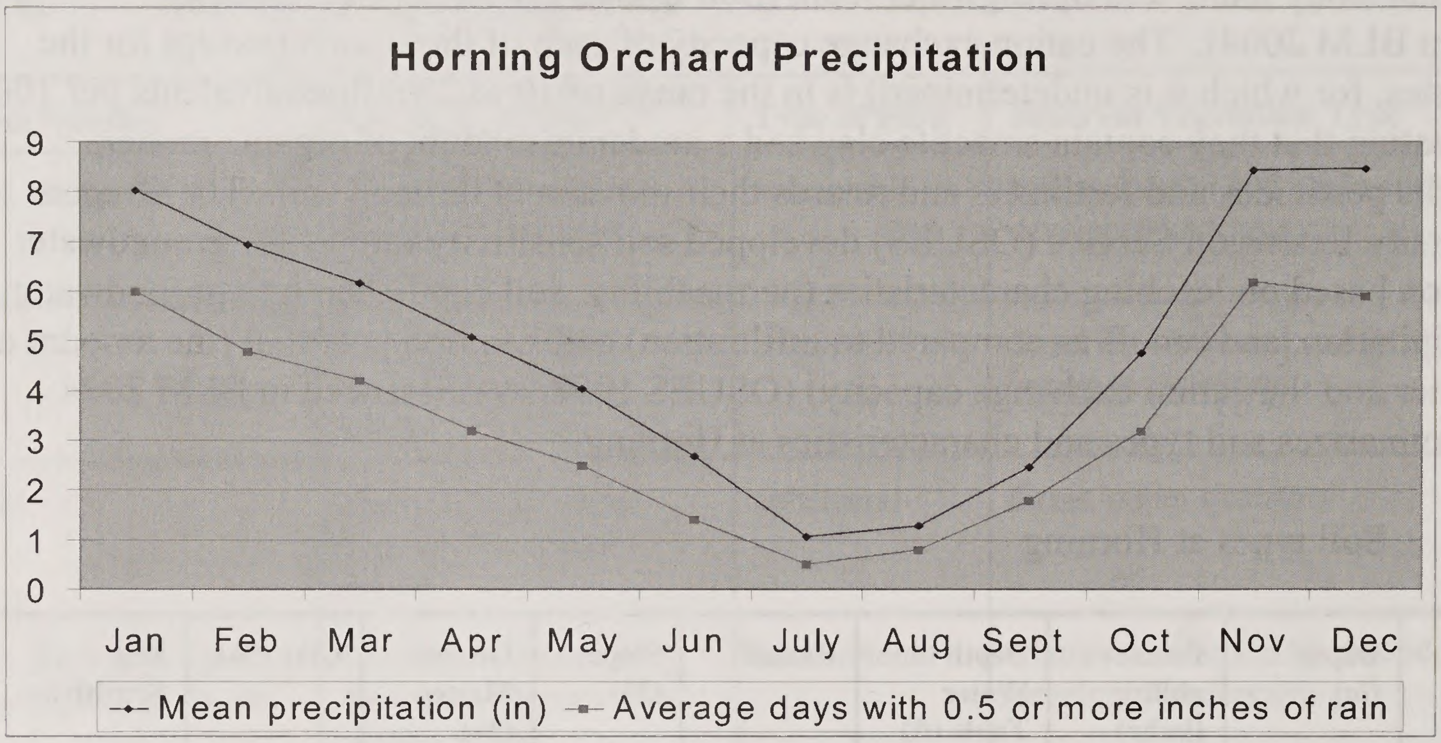
Table 10. Soil types at Horning

Soil Series	Depth (in)	Perme-ability (in/hr)	Depth to Water Table (ft)	Runoff	Slope (%)	Organic Matter (%)	Clay (%)	Soil Sensitivity
Cottrell	0 – 24	0.6 - 2.0	2 - 3 (winter) >6 (summer)	slow	2 - 8	3 - 4	27 - 35	very low
	24 - 55	0.2 – 0.6				0.5 - 3	40 - 50	
	55 - 86	0.2 - 0.6				0 - 0.5	30 - 45	
Jory	0 - 13	2.0 - 6.0	> 6	slow to rapid	2 - 30	3 - 6	27 - 40	very low
	13 - 60	0.2 - 2.0				0.5 - 2	45 - 60	
Klickitat	0 - 15	0.6 - 2.0	> 6	rapid	30 - 60	3 - 6	20 - 27	low
	15 - 35	0.6 - 2.0				0.5 - 3	27 - 33	
	35 - 48	0.6 - 2.0				0 - 0.5	20 -27	
	48 - 52	na				na	na	
Springwater	0 -7	2.0 - 6.0	>6	med.	8 - 15	4 - 6	20 -27	low

Weather. Elevation at Horning ranges from 900 to 1,140 feet above sea level. Its geographical location between the Pacific Ocean and Cascade Mountains results in a maritime west coast climate, featuring mild, wet winters and cool, dry summers. The average July

temperature is 66°F, the average January temperature is 40°F, and average annual precipitation is 59 inches. Most of the precipitation occurs between the months of October and March, Figure 1, consistent with the frequent Pacific storm patterns. Precipitation during the spring and summer months is typically very light. Annual average relative humidity ranges from a high of about 86%, typically in early morning, to a low of 59%, typically in the early afternoon. As recorded at the Portland Airport, winds are predominantly from the northwest throughout the months of April through September and from the east and southeast from October through March.

Figure 1. Horning Orchard precipitation



Effects of the Proposed Action

'Effects of the action' means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 C.F.R. 402.02). If the proposed action includes offsite measures to reduce net adverse impacts by improving habitat conditions and survival, NOAA Fisheries will evaluate the net combined effects of the proposed action and the offsite measures.

'Indirect effects' are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 C.F.R. 402.02). Indirect effects may occur outside the area directly affected by the action, and may include other Federal actions that have not undergone section 7 consultation but will result from the action under consideration. To be considered indirect effects, such actions must be reasonably certain to occur, as evidenced by appropriations, work plans, permits issued, or budgeting; follow a pattern of activity undertaken by the agency in the action area; or be a logical extension of the proposed action.

'Interrelated actions' are those that are part of a larger action and depend on the larger action for their justification; 'interdependent actions' are those that have no independent utility apart from the action under consideration (50 C.F.R. 402.02). Future Federal actions that are not a direct effect of the action under consideration, and not included in the environmental baseline or treated as indirect effects, are not considered in this Opinion.

The application of pesticides, herbicides and fertilizers in proximity to lakes and river systems can result in the transport of potentially toxic chemicals (active ingredients and/or adjuvants) to surface waters (USGS 1999) that may harm ESA-listed species. Pesticides, herbicides and fertilizers can impair the essential biological requirements of salmon if they undermine the physical, chemical, or biological processes that collectively support a productive aquatic ecosystem (Preston 2002) or affect the physiological or behavioral performance of salmonids in ways that will reduce growth and survival, migratory success, or reproduction.

The degree, or likelihood, of effects to listed salmonids from the discharge of pesticides to surface waters vary spatially and temporally, according to factors that have been simplified into the following categories:

- *Likelihood of Exposure.* If listed fish do not occupy habitat that has been chemically modified, the likelihood of adverse effects could be limited to loss of prey base.[10]
- *Water Quality Conditions.* Dissolved oxygen levels and temperature affect salmonids susceptibility to pesticide exposure.
- *Lifestage of the Salmonid.* Salmonids occupy freshwater as incubating eggs/alevins, newly emerged fry, and rearing parr and smolts and as returning adults. Each lifestage has a different susceptibility or tolerance of exposure to pesticides.
- *Levels of other Contaminants.* Concurrent discharge and/or background levels of other contaminants[11] can magnify adverse effects through mixture toxicity resulting from discharges associated with the IPM program.
- *Concentration and relative toxicity of the chemical.*

Within the BA, the BLM evaluated expected effects from the pesticide portion of their IPM using models that assess potential delivery to aquatic systems from drift, surface runoff, and groundwater runoff. While these models are a viable analysis method to evaluate potential water concentrations, they generally do not account for many of environmental variables that can change the effects of pesticide applications. As applied, the models also did not account for the multitude of possible exposures that are proposed over the five-year implementation period. Background or concurrent delivery of pollutants from other sources, and degraded water quality

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[10] 'Prey base' refers to macroinvertebrates and aquatic plants that serve a food sources for juvenile salmonids. A loss of prey base upstream of areas occupied by listed salmon could result in decreased feeding opportunities downstream.

[11] Contaminants range from pesticides, herbicides and nutrients (phosphates and nitrates), to those associated primarily with road and urban runoff including heavy metals, and organics (i.e. oil and grease).

within receiving waterways will add to the risk caused by pesticide delivery from BLM applications.

Most adverse effects to listed salmonids in the action area from the proposed IPM are likely to be sublethal. As stated in Rand (1995), sublethal effects to listed salmonids take the form of behavioral, physiological, biochemical, or histological changes in the exposed fish. These changes may not be immediately lethal, but can cause fish to exhibit impaired behaviors (*i.e.*, narcosis) or eventually develop a lower level of physical health, thus reducing their chances of survival as compared to unexposed fish. Possible consequences include loss of equilibrium, reduced swimming ability, and impaired predator avoidance behavior, which lead to increased predation risk and reduced foraging ability. Increased mixture toxicity between the pesticides and other contaminants in receiving waterways is likely to occur and exacerbate these effects.

General Effects to Aquatic Species From Exposure to Proposed Compounds

The following is a general discussion of effects from the proposed pesticides that are likely to adversely effect ESA-listed species and/or their prey base within the action area. Effects are presented by 'families' of pesticides, that have similar modes of action to aquatic species, and are based on literature reviews and published studies.

Organophosphates. Organophosphates are a group of closely-related pesticides that share a common mechanism of toxicity. The insecticides acephate, chlorpyrifos, diazinon, and dimethoate fall within this organophosphate category and are being proposed for use at Horning. The central and peripheral nervous system is the primary target by disrupting the enzyme that hydrolyzes the nuerotransmitter acetylcholine. Inhibition of this enzyme, acetylcholinesterase, results in an accumulation of acetylcholine which has the effect of continuous stimulation of cholinergic and muscarinic receptors. Organophosphates are highly toxic to fish. Acetylcholinesterase inhibition can result in impairment of biological functioning such as growth, maturation, sensory systems and reproduction. Sublethal behavioral effects can include swimming, foraging, predator avoidance, and disruption of migratory behavior.

Acephate. Acephate is a contact insecticide that is applied to leaf surfaces of plants where it is eaten or comes in contact with pests. Acephate acts by inhibiting the enzyme acetylcholinesterase which is necessary for control of nerve transmission (USDA 1995). Acephate is very water soluble, very mobile in soils, and degrades rapidly in soils under aerobic conditions (EPA 2001). Acephate is considered slightly toxic to aquatic invertebrates and freshwater fish. A summary of toxicity values for aquatic life published in the literature for acephate is found in the Horning RA. Horning proposes to use Acecap® 97, which is 97% acephate in an implant capsule in Horning units. There is no expected risk from capsule implantation to listed salmonids.

Methamidophos. Methamidophos, a degradate of acephate, is considered very highly toxic to aquatic invertebrates and slightly toxic to fish on an acute basis (EPA 2001). Acephate degrades to methamidophos in less than two days. This degradate has a slightly longer half-life

(<10 days) (EPA 2001) and shares the high mobility of its parent pesticide. The BA predicted that acephate will reach water surface waters in negligible concentrations. This is probably due to its short anaerobic half-life, however, nothing is mentioned of its degradate. Methamidphos is significantly more toxic to the prey base of salmonids, more persistent, highly mobile, and carries with it a greater potential for adversely affecting salmonid habitat.

Chlorpyrifos. Chlorpyrifos is very highly toxic to fish and aquatic invertebrates (USDA 1995b). A summary of toxicity values for aquatic life published in the literature for chlorpyrifos is found in the Horning RA. When released into the environment, the half-life of chlorpyrifos ranged from 11 to 141 days in a variety of different soil types; it is thus considered to be moderately persistent (USDA 1995b). The potential for runoff into surface water could occur via erosion up to several months after application. Its degradate, TCP (3,5,6-trichloro-2-pyridinol) is a much more persistent chemical (>365 days) that exhibits much lower soil/water partitioning than chlorpyrifos and is highly water soluble. Within an area of continuous application, accumulated amounts of chlorypyrifos in the soil will eventually degrade into TCP. A storm event could mobilize TCP through dissolution in runoff water and be transported to surface water in a pulse like amount. However, TCP has been found to be much less toxic than chlorpyrifos to aquatic organisms (EPA 2000a).

Diazinon. Diazinon is very toxic to freshwater aquatic organisms and very highly toxic to aquatic invertebrates on an acute basis. A summary of toxicity values for aquatic life published in the literature for diazinon is found in the Horning RA. Exposure to low concentrations (1 ppm or less) has been determined to cause genetic damage and disrupts behaviors that are crucial for reproduction and protection from predators (Cox 2000). Diazinon is moderately mobile in soils and persistent in the environment (37 to 39 days) (EPA 2001b). Diazinon is potentially of the most concern of the organophosphate group. There is a higher exposure probability and risk with more soluble pesticides with longer half-lives than less soluble pesticides with a shorter half-lives. Reduced populations of macro-invertebrates that may result from acute concentrations of diazinon, although temporary, may indirectly effect the health of juvenile salmonids that prey on them.

Dimethoate. Dimethoate is highly toxic to fish and to aquatic invertebrates. A summary of toxicity values for aquatic life published in the literature for dimethoate is found in the Horning RA. Dimethoate is highly soluble and highly mobile in soil, the potential of leaching and runoff to water is high. Dimethoate can be rapidly broken down by most soil microorganisms with soil half-lives ranging generally from 4 to 16 days, but as high as 122 days, have been reported; a representative value would be 20 days (Extoxnet 2000).

Environmental factors may also influence organophosphate toxicity to aquatic species, altering effect estimates to fish. In general, acute toxicity of chlorpyrifos and azinphos-methyl were found to increase with temperature, pH, and body size of the fish. Within the action area, elevated stream temperatures that can stress aquatic life could exacerbate organophosphate toxicity.

The Horning BA lists relevant assessment endpoints and effect concentrations of acephate, chlorpyrifos, diazinon and dimethoate and other relevant organophosphates to salmonid species.

Organosulfites. Propargite is an organosulfur miticide/acaricide that is highly toxic to fish, is moderately persistent (38-168 days), but is immobile in soils, and not very soluble in water. A summary of toxicity values for aquatic life published in the literature for propargite is found in the Horning RA. Having a high affinity for soil and sediment, propargite has the potential to move off the site of application during rainfall/irrigation by erosion/runoff on soil particles and by drift. Given the moderate to slow degradation rates for metabolism and photolysis, and the high Koc[12] values, propargite will probably partition to sediments and organic material if transported to surface waters (EPA 2000b). No data is available on environmental influences to toxicity.

Propargite does not share a common mechanism of toxicity with other pesticides (EPA 2000b), and may not elicit a cumulative risk with other pesticides from a purely mechanistic perspective. However, it is a contributor to the overall pesticide burden that an aquatic organism may experience and could, in combination with other stressors, pose a significant risk in small amounts.

Pyrethroids. Pyrethroids, including esfenvalerate and permethrin, are highly toxic to aquatic invertebrates and fish. The pyrethroid group share similar mechanisms of toxicity, resembling that of Dichlorodiphenyltrichloroethane (known more commonly as 'DDT'), targeting the central and peripheral nervous system, resulting in greatly altered ionic currents and disrupted nerve function through membrane depolarization (Eisler 1992). Disruption to the neuromuscular system, through neurotoxic modes of action, can affect foraging behavior, predator avoidance, swimming performance and other coordinated muscular movement. Environmental factors may also influence pyrethroid toxicity to aquatic species. Toxicity has been known to increase with higher water temperatures, suspended sediments, and acidity.

Esfenvalerate. Esfenvalerate is very highly toxic to aquatic species. A summary of toxicity values for aquatic life published in the literature for esfenvalerate is found in the Horning RA. The persistence of esfenvalerate varies on environmental conditions with half-lives in direct sunlight, soil, and water being 7.5 days, up to 90 days, and 10 to 220 days, respectively. Sub-lethal effects of inhibited olfactory response to a female reproductive pheromone were found at concentrations of less than 0.004 mu g/L or 4 parts per trillion in Atlantic Salmon (Moore and Waring 2001). The same study found exposure of milt and eggs to a concentration of 0.1 mu g/L reduced egg fertilization. These sublethal effects occur at low concentrations that would precede any effects realized at the individual level but could potentially have consequences at the population level.

[12] Koc is a sorption coefficient that is often used to compare the relative mobility of different pesiticides. The higher the Koc value the more strongly the pesiticide is sorbed, and therefore the less mobile it is.

Permethrin. Permethrin is highly toxic to fish and especially aquatic macroinvertebrates. A summary of toxicity values for aquatic life published in the literature for permethrin is found in the Horning RA. Permethrin's water solubility is low and exhibits a strong tendency to bind to soil particles. High amounts of suspended sediment may increase the bioavailability to aquatic organisms.

Nicotinoids. These insecticides include imidacloprid, a relatively new insecticide that acts on the central nervous system of insects, causing irreversible blockage of post synaptic nicotingergic acetylcholine receptors. Imidacloprid is proposed for use only in the form of the Imicide® product, a capsule implanted directly into a tree. Movement of imidacloprid is restricted to the vascular system of the tree and kills insects when they feed. The potential for imidacloprid to enter air, soil, or water is negligible when using Imicide® capsules.

Herbicides. Herbicides can impair the essential biological requirements of salmon if they undermine the physical, chemical, or biological processes that collectively support a productive aquatic ecosystem (Preston 2002). The alteration of watershed characteristics by herbicides can include: Disruption of the growth of riparian deciduous vegetation, reduction of delivery of leaves and intermediate sized wood, and alteration of hydrologic and sediment delivery processes (Spence *et al.* 1986). Moreover, aquatic plants and macroinvertebrates are generally more sensitive than fish to the toxic effects of herbicides. The application of herbicides can affect the productivity of the stream by altering the composition of benthic algal communities, the food source of macro-invertebrates. Benthic algae are important primary producers in aquatic habitats, and are thought to be the principal source of energy in many mid-sized streams (Minshall 1978; Vannote *et al.* 1980; Murphy, 1998). Herbicides can directly kill algal populations at acute levels or indirectly promote algal production by increasing solar radiation reaching streams by disruption of riparian vegetative growth. The disruption of riparian vegetative growth carries with it other adverse consequences for salmonid habitat, such as loss of shade, bank destabilization, and sediment control. Therefore, herbicides can potentially impact the structure of aquatic communities at concentrations that fall below the threshold for direct impairment in salmonids. The integrity of the aquatic food chain is an essential biological requirement for salmonids, and the possibility that herbicide applications will alter the productivity and watershed characteristics of streams and rivers exist.

Herbicides can cause significant shifts in the composition of benthic algal communities at concentrations in the low parts per billion (Hoagland *et al.* 1996). Moreover, based on the data available, herbicides have a high potential to elicit significant effects on aquatic microorganisms at environmentally relevant concentrations (DeLorenzo *et al.* 2001). In many cases, however, the acute sensitivities of algal species to herbicides are not known. In addition, Hoagland et al. (1996) identify key uncertainties in the following areas: (1) The importance of environmental modifying factors such as light, temperature, pH, and nutrients; (2) interactive effects of herbicides where they occur as mixtures; (3) indirect community-level effects; (4) specific modes of action; (5) mechanisms of community and species recovery; and (6) mechanisms of tolerance by some taxa to some chemicals. Herbicide applications have the potential to impair

autochthonous production and, by extension, undermine the trophic support for stream ecosystems.

Glyphosate. Glyphosate, an amino acid derivative, is a broad-spectrum, non-selective systemic herbicide. It is absorbed by leaves, moves rapidly through the plant, and acts to prevent production of an essential amino acid that inhibits plant growth. Glyphosate is slightly toxic to fish, and practically non-toxic to aquatic invertebrate animals (USDA 2001). However, the presence of inert ingredients may exacerbate its toxicity. A summary of toxicity values for aquatic life published in the literature for glyphosate is found in the Horning RA. Glyphosate is strongly adsorbed to most soils, and dissolves easily in water. Glyphosate remains unchanged in the soil for varying lengths of time, depending on soil texture and organic matter content. The half-life of glyphosate can range from 3 to 130 days (USDA 2001). Soil microorganisms eventually break down glyphosate and the potential for leaching is low due to the soil adsorption. Although glyphosate has a low propensity for leaching, it can enter waterbodies by other means, such as overspray, drift, or erosion of contaminated soil (EPA 1993). Once in water, glyphosate is strongly adsorbed to any suspended organic or mineral matter and is then broken down primarily by microbes.

The toxicity of glyphosate to aquatic species increases with increasing temperature and pH (SERA 2003a). In the aquatic environment with freshwater fish, toxicity appears to increase with increasing temperature and pH. As reported in the Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates (USFWS 1980), glyphosate was twice as toxic to rainbow trout at 17c than at seven degrees Celsius. With bluegills, toxicity was twice as toxic at 27c compared to 17c. Toxicity was also two to four times greater to bluegills and rainbow trout at a pH level of 7.5 to 9.5 than at pH 6.5 (PH of 7.0 is considered 'neutral water'). However, the EPA (1993) states that glyphosate is stable at pH 3, 6, 9 at 5 and 35 environmental concentration.

Glyphosate acid and its salts are classified as 'moderately toxic' pesticides by the EPA. Technical glyphosate acid (parent pesticide) is 'practically nontoxic' to fish and may be 'slightly toxic' to aquatic invertebrates. The 96-hour LC50 is 86-140 mg/L in rainbow trout and 120 mg/L in bluegill sunfish. The 48-hour LC50 for glyphosate in daphnia (water flea), an important food source for freshwater fish, is 780 mg/L. The results of a rainbow trout yolk-sac 96-hour LC50 static bioassay yielded results at the 3.4 mg/L level.[13]

There is a very low potential for the pesticide to build up in the tissues of aquatic invertebrates or other aquatic organisms.[14] In one study of bioaccumulation and persistence, glyphosate was applied to two hardwood communities in Oregon coastal forest and none of the 10 coho salmon fingerlings analyzed had detectable levels of the herbicide or its metabolite

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[13] USGS acute toxicity website: http://www.cerc.usgs.gov/data/acute/acute.html

[14] Extoxnet website: http://extoxnet.orst.edu/

aminomethylphosphonic acid, although levels were detectable in streamwater for three days and in sediment throughout the 55-day monitoring period.[15]

Dicamba. Dicamba is a member of the benzoic acid chemical family. Benzoic acid herbicides are similar in mode of action and structure to the phenoxy herbicides, such as 2,4-D. Like phenoxy herbicides, dicamba mimics a plant growth hormone, affecting cell division (Cox 1994). Study results in aquatic organism toxicity have yielded varying results. Dicamba is slightly toxic to fish and may be toxic to aquatic macroinvertebrates (SERA 1999). A summary of toxicity values for aquatic life published in the literature for dicamba is found in the Horning RA. Dicamba is moderately persistent in soil and highly mobile in soil. Half-lives vary significantly, from one to six weeks (EPA 1983), with the typical half-life being four weeks (Weed Sci Soc Amer 1983). When applying dicamba, exposure to non-target species may be difficult to control due to its high volatility (SERA 1999).

Dicamba is categorized by the EPA as 'slightly toxic' to fish, and 'practically non-toxic to aquatic organisms. The LC50 (96-hour) for technical dicamba is 135 milligrams per liter (mg/L) in rainbow trout (O. mykiss) and bluegill sunfish (Lepomis microchirus). The LC50 (48-hour) for dicamba is 35 mg/L in rainbow trout (USDA 2001). It is important to note that although dicamba is 'slightly toxic' to fish, there are variations in study results with reference to salmonids. One study found that there were no effects on yearling coho salmon (O. kisutch) at concentrations up to 100 parts per million (ppm). However, yearling coho were killed by much smaller doses (0.25 ppm) during a seawater challenge test that simulated their migration from river to ocean (Cox 1994). Little is known about sublethal effects on fish.

Dicamba does not bind to soil particles. Microbes appear to be the primary source of chemical breakdown the soil. In sterilized soil, over 90% of applied dicamba was recovered after four weeks, suggesting that microbes were responsible for the decomposition. Sunlight does not appear to play a major role in breakdown, as with many other herbicides. Volatilization (vaporization) of dicamba from soil surfaces may not be an important process, although some volatilization can occur from plant surfaces. The principal soil metabolite appears to be 3,6-dichlorosalicylic acid.

Picloram. Picloram is a pyridine carboxylic acid herbicide that acts as a plant growth regulator (SERA 2003c). It is absorbed by the plant roots, leaves and barks. It moves both up and down within the plant, and accumulates in new growth, interfering with the plant's ability to make proteins and nucleic acids. It is moderately toxic to fish and slightly toxic to aquatic invertebrates. Picloram is highly soluble in water, resistant to biotic and abiotic degradation processes, and degrades very slowly with half-lives ranging from 167 to 513 days (EPA 1995). Its major route of dissipation appears to be leaching. Given its high persistence, it appears unlikely that picloram will degrade once it reaches ground water, even over a period of several years (EPA 1995). While not as toxic as other the chemicals examined in this consultation, the

[15] Toxnet website: http://toxnet.nlm.nih.gov

environmental fate characteristics of picloram may ensure introduction into coho habitat and subsequent exposure.

Fungicides. Chlorothalonil is a member of the polychlorinated benzene carbonitrile fungicide class of pesticides. The results of the 96-hour acute toxicity studies indicate that chlorothalonil is very highly toxic to fish and aquatic macroinvertebrates (EPA 1999). A summary of toxicity values for aquatic life published in the literature for chlorothalonil is found in the Horning RA. There is a lack of data on the effects on early life stages, sublethal behavioral effects or environmental influences on toxicity.

Chlorothalonil is almost non-soluble in water, not generally been considered a highly mobile pesticide, and is more likely to be found in runoff from treated areas. The persistence of chlorothalonil varies with environmental conditions and is resistant to hydrolysis, photolysis, and volatilization, and only moderately susceptible to degradation in soil under aerobic conditions (EPA 1999). Chlorothalonil can contaminate surface water via spray drift or through runoff and erosion. Chlorothalonil in the soil under aerobic conditions degrades to SDS-3701. SDS-3701 appears to be more persistent, mobile, and available for runoff for longer periods than chlorothalonil. However, studies have shown that SDS-3701 is significantly less toxic than parent chlorothalonil (EPA 1999).

Adjuvants. Numerous adjuvants, solvents, and other 'inert' ingredients are also contained in pesticide formulations, many of which are toxic to aquatic species (Stark and Walthall, 2003), and consequently are also applied in the watersheds. Frequently used adjuvants include surfactants such as nonylphenol polyethoxylates, alkylbenzene sulfonate, polyethoxylated alkyl amines, and others. Toxic solvents include kerosene, naphthalene, cyclohexanone, ethylbenzene, xylene, a variety of oils, and other pesticides. Inert ingredients are generally inclusive of adjuvants and solvents, but may include other additives as well. The proprietary nature of many pesticide formulations can make analyzing pesticide formulation toxicity mechanisms difficult due to undisclosed ingredients. In addition, in some cases, the pesticide active ingredient may be less toxic to aquatic species than the 'inert' ingredients.

Adjuvants include the following:

1. Surfactants (surface-active ingredients). These are substances that improve the emulsifying, dispersing, spreading, wetting, or other surface-modifying properties of liquids. Surfactants include emulsifying agents, crop oils, concentrates, and stickers.
2. Emulsifying Agents. An emulsion is a mixture of two incompletely mixed liquids, one which is dispersed in the other. Emulsifying agents work to promote the suspension of one liquid in the other. In herbicides, there are two types of emulsions: "Oil-in-water" emulsion, in which the spray mixture is similar to water, and "water-in-oil" emulsion, a rather viscous spray, also called "invert" emulsions. The "oil-in-water" emulsions are widely used in the formulation of herbicides to aid in getting an oil-soluble herbicide dispersed in a water mixture so that the active ingredient may be applied as a water spray.

Inert emulsions are used to aid in drift control, to improve resistance of the herbicide treatment to the effects of weather (rain), to improve accuracy of delivery of the herbicide, and to enhance herbicide activity.

3. Wetting Agents (spreaders). Spreaders are added to decrease surface tension in a mixture and cause a larger portion of each spray droplet to come in contact with surface of the vegetation. The goal is to increase coverage and effectiveness, although it may also alter herbicide selectivity. There are four spreader types: (1) Anionic, which has an electrical charge in water; (2) Cationic, which has an electrical charge in water; (3) Nonionic, which does not have an overall electrical charge; and (4) Amphoteric, which has positive or negative charges, depending on the pH of the solution.
4. Drift Control Agents. Drift of herbicide sprays can be a problem in some environments. One way to reduce herbicide drift is to increase the droplet size of the spray. Adjuvants that are used to control drift do so, in part, by reducing the number of fine spray droplets. Thickeners may be used as drift control agents.
5. Crop Oil Concentrates. These are products that contain 80-85% petroleum or vegetable oil and 14-20% surfactant and emulsifiers. An "emulsifiable oil", on the other hand, is a product that contains 98% oil and 1-2% emulsifiers. This group is also called "nonphytotoxic oils" and "phytobland oils."
6. Stickers. These are adjuvants that cause herbicide to stick to foliage and prevent runoff from target vegetation. The desired result is increased effectiveness.
7. Compatibility Agents. These are adjuvants that aid in the suspension of herbicides when they are combined with other pesticides or fertilizers. Used primarily when the carrier solution is a liquid fertilizer.
8. Acidifiers and Buffers. Acidifiers are acids that neutralize alkaline solutions and lower pH when added to herbicide, while buffers can change the pH to a certain level and maintain it, even if the alkalinity changes.
9. Antifoaming Agents and Spray Colorants. Defoaming agents and dyes.

Specific Inert Ingredients Known to be Present in Products Proposed for Use.

Cyclohexanone. Cyclohexanone is present in the Digon® 400 formulation of dimethoate.

Ethylbenzene. Present in the Asana® XL formulation of esfenvalerate and the Pounce® 3.2 EC formulation of permethrin. This inert ingredient is most commonly found in vapor form since it moves easily into the air from water and soil. In the air, ethylbenzene is broken down by sunlight in approximately 3 days. In surface water, it breaks down by reacting with other pesticides. In soils, ethylbenzene is broken down by bacteria.

Light aromatic solvent naphtha. Present in the Pounce® 3.2 EC formulation of permethrin. Light aromatic solvent naphtha is slightly toxic to terrestrial species, as illustrated by the data summarized in the RA.

Petroleum distillates. Present in the Digon® 400 formulation of dimethoate.

Xylene. Present in the Asana® XL formulation of esfenvalerate and the Pounce® 3.2 EC formulation of permethrin. The inert ingredient xylene very quickly evaporates into the air from surface water and soil where it may remain for several days until it is broken down by sunlight. Because xylene is applied as a liquid, it does have the potential to infiltrate into the soil. Most xylene insurance water evaporates into the air in less than a day. Xylene is more persistent in ground water where evaporation is impaired.

In some cases, the pesticide active ingredient may be less toxic to aquatic species than the 'inert' ingredients. The herbicide glyphosate provides a classic example. The LC50 values for rainbow trout range for technical grade glyphosate range from 86 mg/L to 140 mg/L (EPA, 1993). However, LC50 values for rainbow trout to glyposate formulations range from 8.2 mg/L to >1000 mg/L (EPA 1993), depending on the adjuvants and surfactants added.

Herbicide mobility in soil can be increased by the use of surfactants, but effects to mobility are unlikely due to the relatively low concentration of surfactants in the soil/water matrix at Forest Service application rates (Bakke 2002) which are comparable to BLM application rates. In general, it appears that aquatic species are more susceptible to adverse effects from surfactants than terrestrial species. At least some of the aquatic sensitivity to surfactants is due to irritation of gill membranes and alteration of their permeability and molecular exchange properties.

Impurities may also pose risks for aquatic species. Hexachlorobenzene, classified as a human carcinogen, is an impurity in picloram (SERA 2003). Hexaclorobenzene is ubiquitous and persistent in the environment. Under typical application scenarios, it volatilizes from the soil or vegetation surface, but can bioconcentrate in fish if it reaches aquatic habitats. Hexachlorobenzene can contaminate water by runoff or volatilization and deposition in rainwater. Because hexachlorobenzene binds tightly to soil, it is not likely to percolate through soil to contaminate groundwater.

Effects of IPM Implementation

Chemical use within the proposed IPM program is reasonably likely to result in sublethal adverse effects to listed salmonids within the action area. Within the past several years, the following studies documented that significant sublethal effects to salmonids can result from exposure to pesticides and other toxic pesticides. Sandahl *et al.* (2004) documented that chlorpyrifos (an organophosphate insecticide) and copper (a metal) both caused loss of olfactory sensory function in juvenile coho salmon at environmentally relevant concentrations. A 20% reduction in olfactory sensory function occurred at 4.4 μg/l for copper and 0.72 μg/l for chlorpyrifos. In addition, Sandahl *et al.* (2004) demonstrated that a concentration of 0.2 μg/l of the insecticide esfenvalerate evoked distinct and irregular bursts of postsynaptic activity in the olfactory bulb of juvenile coho salmon. These effects could interfere with olfactory mediated behaviors that are important for the survival and migration of salmonids.

Scholz *et al.* (2000) documented sublethal behavioral effects in Chinook salmon from the insecticide diazinon at concentrations as low as 1.0 μg/l. Since the behavioral effects observed

by Scholz *et al.* included inhibition of predator avoidance, the 'sublethal' exposure could ultimately result in death.

Accurate assessment and understanding of sublethal effect thresholds are further complicated by allostatic loading, as described by McEwen and Wingfield (2003). Briefly, allostatic loading results when organisms are exposed to multiple stressors during their life cycle that reduce the chance of reproductive stress. As summarized within the Environmental Baseline section of this Opinion, numerous herbicides, insecticides and pesticide breakdown products have been detected in the lower Clackamas River. Within all of the sampling, pesticides were always detected with at least one other pesticide. Within half of the sampling, six or more pesticides were detected at the same time (USGS 2003). NOAA Fisheries is unaware of analogous sampling within the Molalla River and its tributaries, though land use within the basin is likely to contribute to chemical contamination. In the Clear Creek/lower Clackamas River and the Molalla Basin, listed salmonid smolts and adults are most likely exposed to a mixture of at least some of these pesticides, plus additional pollutants from roads, urban areas, and industries, as well as stressors from degradation of other habitat sub-elements (water temperature, pool/riffle ratios, *etc.*). Given the results of the studies discussed above and the emerging understanding of the risks of allostatic loading, the pesticides in the proposed action (including other organophosphates and pyrethroids) have the potential for significant low-dose sublethal effects.

Further, in a study of environmental contaminants on behavior, Weis *et al.* (2001) stated: "It is assumed that effects at the molecular and cellular levels precede detectable effects at the individual organism level, which precede effects at the population and community level." As evidence, Weis (2001) found that neurotoxic effects at the biochemical level altered the predator-prey behavior of the mummichog, (*Fundulus heteroclitus*) which then had consequences that were in clear connection on the population and community structure such as reduced growth and condition. Pollution exposure, whether it be from elevated pesticide concentrations or more conventional impacts such as anoxia or high temperature, may also lead to reduced growth rates and infection for juvenile salmonids but even these responses are preceded in time by effects at the molecular level and can have connections to the population and community level.

Most adverse effects from the chemical portion of the IPM plan are likely to be sublethal, which can be further divided into narcosis and rheotropism. Sublethal or nonlethal endpoints do not require that mortality be absent; rather, they indicate that death is not the primary toxic endpoint being examined. Rand (1995) states that the most common sublethal endpoints in aquatic organisms are behavioral (*e.g.*, swimming, feeding, attraction-avoidance, and predator-prey interactions), physiological (*e.g.*, growth, reproduction, and development), biochemical (*e.g.*, blood enzyme and ion levels), and histological changes (*e.g.*, degenerative necrosis of the liver, kidneys, and gill lamellae; Lorz *et al.* 1979). Some sublethal effects may indirectly result in mortality. Changes in certain behaviors, such as swimming or olfactory responses, may diminish the ability of the salmonids to find food or escape from predators and may ultimately result in death. Some sublethal effects may have little or no long-term consequences to the fish because they are rapidly reversible or diminish and cease with time. Individual fish may exhibit different responses to the same concentration of toxicant. The individual condition of the fish can

significantly influence the outcome of the toxicant exposure. Fish with greater energy stores will be better able to survive a temporary decline in foraging ability, or have sufficient metabolic stores to swim to areas with better environmental conditions. Fish that are already stressed are more susceptible to the deleterious effects of contaminants, and may succumb to toxicant levels that are considered sublethal to a healthy fish.

Narcosis and rheotropism, discussed further below, are two types of sublethal effects that compromise salmonids ability to migrate, feed, and seek refuge from predators. In some instances, sublethal effects such as reduced predator avoidance, may indirectly result in injury or mortality to ESA-listed salminds, through increased predation.

Sublethal Effect - Narcosis. When exposed to elevated concentrations of polar and nonpolar organic pesticides, fish can become narcotized. Narcosis is a generalized nonselective toxicity response that is the result of a general disruption of cell membrane function. The process of narcosis is poorly understood, but is thought to involve either a ‘critical volume’ change in cellular membranes due to the toxicant dissolving into the lipid membrane and altering its function, or by the ‘protein binding’ process in which hydrophobic portions of receptor proteins in the lipid membrane are bound by the toxicant molecules, thus changing the receptor protein’s function (Rand 1995). A fish with narcosis is more susceptible to predation as a result of a loss of equilibrium, a reduction in swimming ability or a lack of predator avoidance behavior. Furthermore, a fish with narcosis also has difficulty maintaining its position in the water column, and can be carried by water currents into areas of sub-optimal water quality.

Sublethal Effect - Rheotropism. Rheotropism refers to fish behavior in a current of water, either directly as a response to water flowing over the body surface or indirectly as a response to the visual, tactile or inertial stimuli resulting from the displacement of fish in space (Dodson and Mayfield 1979). Several studies involving the herbicide 2, 4-D (which is not proposed for use in the IPM) provide example’s of rheotropism. Folmar (1976) used rainbow trout fry in an investigation to determine whether fish avoided water contaminated by 2, 4 D. At concentrations of 1.0 or 10.0 mg/litre of 2,4-D, there was significant avoidance of the chemical. Similarly, Dodson and Mayfield (1979) assessed the effect of 2,4-D on the reotaxic response (the tendency to swim upstream to compensate for flowing water) of rainbow trout. The report stated that, at ‘realistic concentrations’ of 2,4-D in water, there would be a tendency for fish to be moved downstream because of a reduced reotaxic response.

Chemical Interactions and Mixture Toxicity. Rand (1995) states that in ‘assessing chemically induced effects (responses), it is important to consider that in the natural aquatic environment organisms may be exposed not to a single chemical but rather to a myriad or mixture of different substances at the same or nearly the same time. Exposures to mixtures may result in toxicological interactions.’ A toxicological interaction is one in which exposure to two or more chemical residues results in a biological response quantitatively or qualitatively different from that expected from the action of each chemical alone. Exposure to two or more chemicals simultaneously may produce a response that is simply additive of the individual responses or one that is greater (synergistic) or less (antagonistic) than expected from the addition of their

individual responses. Application of pesticides within the IPM is likely to contribute to elevated toxicological responses caused by other sources of chemical pesticides within the action area. As discussed within the cumulative effects section, at least 27 different herbicides/pesticides are applied within the Clackamas Watershed (USGS 2003).

The temporal and spatial variability of the composition of mixtures, along with local water quality parameters, makes understanding and predicting relative effects a complex and challenging task. Furthermore, Sub-lethal effects, which by nature are less apparent than lethality, have rarely been studied in conjunction with exposure to chemical mixtures (Kraak et al. 1994 as cited in Forget *et al.,* 1999).

Given the proposed five-year implementation of the IPM plan and the number of herbicides and pesticides and application events, many discreet variables will influence relative effects (*i.e.*, exposure) to listed salmonids. Variables range from weather (wind/rain/temperature/humidity), the fate characteristics of the pesticide, herbicide or fertilizers, implementation of CPs, the particular application area's topography and composition of the nearest waterway buffer, the lifestage of the salmonid, relative water quality, and background concentrations from non-BLM applications. The pathways of potential exposure to listed salmonids and their prey base can be from waterborne delivery, either through overland flow or subsurface flow, or through airborne drift soon after application.

To explore the likelihood/magnitude of exposure from individual applications, the BLM addressed predicted effects from the standpoint of the lowest observable effects level from individual pesticides, herbicides and fertilizers. The BLM incorporated several models to conduct this analysis. Drift was modeled through the Agricultural Drift (AgDRIFT) model and runoff was predicted using the GLEAMS and MOC models. The use of models to predict environmental concentrations resulting from pesticide, herbicide and fertilizer use is complicated by the wide range variables described above. To simplify the task, the BLM incorporated a limited number of application scenarios based on anticipated operations and circumstances. While the scenarios chosen in the RA are intended for use in predicting expected conditions, a conservative bias or worst possible case scenario was incorporated when assumptions were required. General model assumptions are discussed below, and discussed in more detail further within this analysis:

The GLEAMS model was used to predict runoff of chemicals and water as they might be measured at the edge of each orchard unit. However, the Horning units generally have significant areas of untreated field edges and well-vegetated buffers between treated acreage and receiving streams. These untreated intervening areas, collectively termed 'buffer zones,' are expected to have a significant effect in reducing the amount of chemicals that actually reach streamwater. To account for the attenuating effect of buffer zones, the MOC model was set up to represent steady saturated shallow subsurface flow across a minimum 30-foot buffer zone. The fate and transport modeling assumptions used in the RA correspond to the pesticide application details of (Maximum Production IPM), and that the proposed action (Alternative B, IPM with Environmental Protection Emphasis) actually contains additional limitations on certain aspects

of chemical pesticide and fertilizer use to provide added protection to human health and the environment.

The proposed action was developed based on the results of the RA. These limitations, such as the use of wider buffers for certain pesticide application methods, provide additional protection against the possibility of adverse effects to listed fish species.

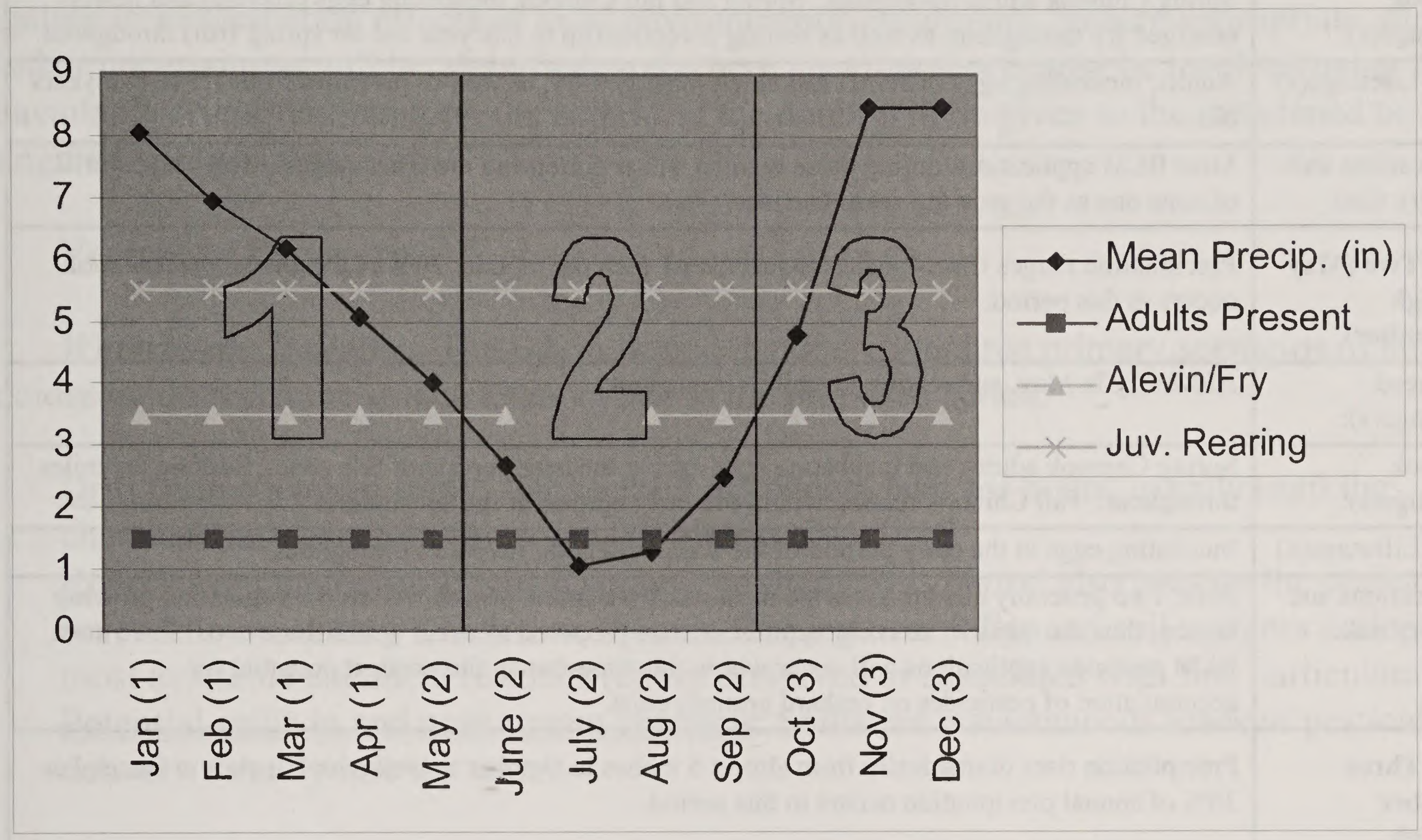
The BLM used the Quotient Method (EPA 1986) in their BA to evaluate risk to aquatic organisms and threatened salmonids. However, the method is based on lethal response and assumes that the dose/response curve resembles a typical curve produced from a toxicological model presented in the 1975 Regulations for the Enforcement of the Federal Insecticide, Fungicide, and Rodenticide Act (40 C.F.R. 154). Furthermore, the EPA (1986) states that the procedure does not indicate the 'probability of adverse effects,' and that they 'view the risk of criteria with their safety factors as 'rough' estimates of potential risk to non-target species.' Similarly, NOAA Fisheries does not currently recognize this method as being sufficiently protective of ESA-listed species. In the context of this consultation and given the lack of more specific information to the contrary, NOAA Fisheries considers the 1/20th value procedure as a conservation measure that attempts to minimize, though not avoid, lethal or sublethal effects in coho salmon. NOAA Fisheries has used the 1/20th value in conjunction with the LC50 value and the most conservative sublethal effect concentration available in the literature to assist in evaluating the effects of the proposed action.

For sublethal effects, the lowest observed effect concentration (LOEC) from each of the three assessment endpoints was selected for the risk evaluation. The selected LOECs are intended to be the most conservative, representative estimates available for adverse effects at all life-stages related to survival, migration, or reproduction. The estimated pesticide concentration over the sublethal effect level was defined as an effects ratio. Risks to survival, migratory, and reproductive endpoints were determined to be low if the effects ratio was 0.1 or below, moderate if 0.1 to 1.0, and high if 1.0 or greater.

While the modeling assumptions are conservative, it is important to note model results just express output concentrations from applications that do not account for potential multiple exposures to listed fish and to their supporting ecosystems. Multiple exposures to single or combined pesticides, herbicides and fertilizers from the proposed multi-year, multi-location BLM applications may be delivered to non-target aquatic habitats, particularly during fall and spring runoff events. Potential non-target runoff areas support each of the listed salmonid life history stages. Repeated exposure to the same pesticides, herbicides or fertilizers or from exposure to mixtures are likely to result in adverse effects to listed salmonids. Moreover, the risk of adverse effects increase when BLM produced pesticide herbicide or fertilizer runoff is added to waterways that are already contaminated. The BA indicates that receiving waterways with listed fish have elevated temperatures during certain periods of the year. Studies have demonstrated that elevated temperatures may increase the susceptibility of listed fish or their prey base to small concentrations of pesticides, herbicides or fertilizers (Folmar *et al.* 1979; Woodward 1976; Kumaraguru and Beamish 1986).

For the purpose of this analysis, the calendar year has been divided into three general zones of exposure risk to listed salmonids from the proposed action, as depicted in Figure 2. Through these three zones, the precipitation and number and type of pesticide, herbicide and fertilizer applications determine the relative risk to listed salmonids.

Figure 2. Timing of listed species by lifestage and annual precipitation - Horning



Corresponding to Figure 2, the precipitation and lifestages and relative risk of exposure has been summarized in Table 11.

Table 11. Precipitation, lifestage, and application/delivery risk to listed salmonids

Zone One (January through April)	Precipitation: Ranges from 5-8 inches per month. 50% of annual precipitation occurs in this period.
Steelhead Lifestage(s):	Adults, incubating eggs (alevins) and newly-emerged fry, as well as juveniles up to 1.5 to two years old.
Chinook Lifestage(s):	Spring Chinook adults throughout. Spring and fall Chinook incubating eggs (alevins) and newly-emerged fry throughout, as well as rearing juveniles (up to one year old for spring fish) throughout.
Coho Lifestage(s)	Adults, incubating eggs (alevins) and newly-emerged fry, as well as juveniles from 1.5 to two years old.
Applications and delivery risk:	Most BLM applications during those months will occur during the latter stages (March and April) of zone one as the growing season arrives.
Zone Two (May through September)	Precipitation ranges from 4 inches to just over 1 inch per month. 20% of the annual precipitation occurs in this period.
Steelhead Lifestage(s):	Alevin/fry in May, and rearing juveniles throughout.
Chinook Lifestage(s):	Spring Chinook adults, and incubating eggs during the later portion of this zone. Rearing juveniles throughout. Fall Chinook rearing within the early portion of the zone only.
Coho Lifestage(s)	Incubating eggs in the early portion of the zone. Rearing juveniles throughout.
Applications and delivery risk:	Zone Two generally encompasses the most risk from insect pest as well as the vegetation growing season, thus the majority of BLM applications are proposed to occur within zone two. Since most BLM pesticide applications will occur within this time-frame, the greatest potential for accumulation of pesticides on orchard grounds exist.
Zone Three (October through December):	Precipitation rises dramatically from almost 5 inches in October to well over 8 inches in December. 30% of annual precipitation occurs in this period.
Steelhead Lifestage(s):	Rearing juveniles are present during this zone.
Chinook Lifestage(s):	A few remaining Spring Chinook adults in October, incubating eggs and some alevins, rearing juveniles throughout. Fall Chinook adults and incubating eggs throughout.
Coho Lifestage(s)	Adults, juveniles and incubating eggs throughout.
Applications and delivery risk:	Most BLM applications during those months will occur during the beginning of this zone, though there may be several applications (over the five-year term) in each month. The increase in precipitation during this zone could deliver pesticides that have accumulated (but not yet delivered to aquatic systems) on orchard grounds from zone one, and particularly zone two through runoff and subsurface flow pathways.

<u>Factors of Uncertainty</u>. Predicting exposure levels or effects from specific exposure levels is difficult because of the uncertainty inherent in the tools used to conduct effects analyses. Sources of analytical tool uncertainty are lack of information regarding laboratory to field extrapolation, mixture effects, toxicity and behavior of degradation/metabolic products, use of physiologically/ecologically relevant endpoints based on the pesticide mechanism of action, and reliance on short-term toxicity tests. All of these sources of uncertainty fall into one or more of three basic categories: Parameter uncertainty (measurement, sampling, and systematic errors),

modeling uncertainty (simplification of real world processes, model misuse, use of inappropriate surrogates), and scenario uncertainty (descriptive, aggregation, and professional judgement errors).

Examples of sources of uncertainty associated with the proposed project are: (1) The fate of herbicides in streams; (2) modeling uncertainty; (3) the site-specific foraging habits of salmonids and the vulnerability of key prey taxa; (4) the toxicity of pesticide mixtures; and (5) the mitigating or exacerbating effects of local environmental conditions. Where appropriate, these and other uncertainties will be identified, and where uncertainties cannot be resolved using the best available scientific literature, the benefit of the doubt will be given to the threatened or endangered species in question.

Vectors of Exposure.

Waterborne Delivery. The BA indicated that there are three primary scenarios of how pesticides could reach the stream channel due to the proposed action:

1. Drift from chemical spray. This period of concern lasts for hours, usually until the chemical has been allowed to dry on foliar surfaces.
2. Runoff from the fields to which spray is applied. This period also lasts on the scale of several hours, during which time the rain flowing over foliar and soil surfaces collects the most available chemical residues (either dissolved or associated with fine particulate).
3. Potential spills in and near stream channels. Spills are instantaneous loads of pesticide delivery directly into the water.

These scenarios have the potential to transport chemicals to adjacent drainages and waterways which listed salmonids occupy for migration, rearing, and spawning. Large amounts of precipitation which expands the ephemeral stream system can result in flowing water coming into contact with pesticide deposits (Norris 1980 as cited in Dent and Robben 2000). The adsorption potential, stability, solubility, and toxicity of a chemical determines the extent to which it will migrate and adversely effect surface waters and groundwater (Spence *et al.* 1996).

Chemical Drift. Drift occurring immediately after application is one way that exposure to non-target species may occur outside the application area. In evaluating drift effects to non-target species, the BLM modeled off-target pesticide drift from ground vehicle and hand methods of pesticide applications using AgDRIFT, a cooperative model developed by the EPA Office of Research, the USDA Agricultural Research Service, the USDA Forest Service, and the Spray Drift Task Force.

Aerial, ground vehicle, and hand methods of pesticide applications could result in spray drift and volatilized chemicals. Data from field studies were used to characterize drift from applications using high-pressure hydraulic sprayers, hand-held wands, and backpack sprayers. For all applications, the highest of the deposition values predicted for all potentially treated areas was used as the input to the quantitative risk calculations. The AgDRIFT model was used to estimate

off-target drift deposition from ground boom applications of the herbicides dicamba and glyphosate.

Drift is dependent on gravity, air movement, and droplet size.[14] Smaller droplets stay aloft longer and the longer a droplet is suspended the greater the potential for it to be translocated by air currents. A droplet size of 100 microns (mist) takes 11 seconds to fall 10 feet in still air. The same size droplet would travel 13.4 feet in a 1 mph wind while dropping that same 10 feet, and 77 feet at 5 mph. Application pressure, nozzle size, nozzle type, spray angle, and spray volume are all factors in determining droplet size. Droplet sizes increase with decreasing pressure and larger nozzle sizes. An indicated droplet size (*i.e.*, 300 microns) actually represents a median diameter of all droplets. Actual droplet sizes will range from considerably smaller as well as larger than the indicated droplet size. During temperature inversions little vertical air mixing occurs and drift can translocate contaminates several miles. In addition, low relative humidity and/or high temperature conditions will increase evaporation and the potential for drift. Proposed buffers, application criteria, and concurrent drift monitoring reduce this risk. Application during calm conditions would reduce spray drift. Modeling was completed using the following scenarios.

Parameter	Typical Scenario	Maximum Scenario
Boom height above canopy	15 feet	15 feet
Swath width	45 feet	45 feet
Wind speed	3 mph	6 mph
Temperature (April 15)	40 °F	40 °F
Temperature (May 31-June 1)	60 °F	60 °F
Temperature (July 1)	----	70 °F
Relative humidity (April 15)	75%	75%
Relative humidity (May 31-June 1)	----	65%
Relative humidity (July 1)	----	50%

Predicting environmental concentrations resulting from pesticide and fertilizer use at Horning is complicated by the wide range of chemical, environmental, and operational assumptions. The modelers dealt with this uncertainty by choosing a limited number of scenarios based on anticipated operations and circumstances.

For all applications, the highest of the deposition values predicted for all potentially treated areas was used as the input to the quantitative risk calculations. No drift beyond buffer areas is expected from other ground application methods, based on the results of field studies summarized in the RA report.

For both aerial and ground applications, the highest of the deposition values predicted for all potentially treated areas was used as the input to the quantitative risk calculations. No drift

[14] NebGuide website at http://www.ianr.unl.edu/pubs/pesticides/g1001.htm

beyond buffer areas is expected from other ground application methods, based on the results of field studies summarized in the RA report.

Table 12 shows a comparison of the exposure profile data (estimated water concentrations from spray drift) specific to Clear and Milk Creeks to stressor-response profile data taken from attachment C of the BA to estimate the risk of adverse effects. The estimated surface water concentrations are extremely low, several orders of magnitude below the levels of concern. The levels of concern are determined following the quotient methodology used by EPA's Office of Pesticide Programs (see Sec 9.1 in Horning RA).

Table 12. RA-Modeled Stream Concentrations of Pesticides Under the Proposed Action Resulting from Application Drift, and Salmonid Effect Concentrations Selected by NOAA Fisheries for Effects Evaluation.

	Milk Creek		**Clear Creek**		**Effect Concentration**		
Pesticide	**Typ**	**Max**	**Typ**	**Max**	**LOEC (mg/L)***	**End-point**	**REF**
Aerial (helicopter)							
Esfenvalerate	8.78E-010	2.45E-007	4.53E-009	3.40E-007	2.50E-005	predation	Little *et al.* 1993
-Ethylbenzene	1.04E-010	2.92E-008	5.39E-010	4.85E-008	14	mortality	Mayer and Ellersieck 1986
- Xylene	3.13E-010	8.76E-008	1.62E-009	1.45E-007	0.1	rearing	Folmar 1976
Airblast sprayer							
Chlorpyrifos	1.76E-007	7.09E-006	3.90E-006	1.48E-005	0.003	mortality	EPA 2000
Esfenvalerate	8.78E-009	3.57E-007	2.24E-007	6.46E-007	2.50E-005	predation	Little *et al.* 1993
-Ethylbenzene	1.05E-009	4.25E-008	2.66E-008	8.95E-008	14	mortality	Mayer and Ellersieck 1986
- Xylene	3.14E-009	1.28E-007	7.99E-008	2.68E-007	0.1	rearing	Folmar 1976
Permethrin	2.51E-007	3.12E-007	-0-	-0-	7.5E-004	predation	Kumaraguru *et al.* 1982
-Ethylbenzene	3.38E-007	6.15E-007	-0-	-0-	14	mortality	Mayer and Ellersieck 1986
-Light arom solv naphtha	5.44E-006	9.90E-006	-0-	-0-	0.32	mortality	EPA 2001
-Xylene	1.72E-006	3.14E-006	-0-	-0-	0.1	rearing	Folmar 1976

Pesticide	Milk Creek Typ	Milk Creek Max	Clear Creek Typ	Clear Creek Max	Effect Concentration LOEC (mg/L)*	Effect Concentration End-point	Effect Concentration REF
Tractor-pulled spray rig with boom							
Propiconazole	-0-	-0-	5.55E-008	9.16E-008	0.24	mortality	Grande *et al.* 1994
Dicamba	3.55E-011	3.97E-011	1.15E-006	3.56E-006	1.8	mortality	Mayer and Ellersieck 1986
Glyphosate -circles around trees	7.67E-012	5.48E-012	-0-	-0-	0.046 (NOEC)	migration and growth	Morgan and Kiceniuk 1992
Glyphosate -strips between rows	3.24E-011	2.67E-011	1.17E-006	1.94E-006	0.046 (NOEC)	migration and growth	Morgan and Kiceniuk 1992

* Selected LOEC's are for various species of fish and might be less for aquatic macroinvertebrates (relevant to all tables)

** Numerical values represent scientific notation.

From the perspective of viewing each pesticide, herbicide and fertilizer application as a stand-alone event, the likelihood of direct adverse effects to listed salmonids from drift are remote. The attenuating effects of vegetative buffer zones, the conservative nature of the analysis, the ecological protection measures in place (as described within the proposed action), and the individual modeled concentrations lead to this conclusion.

However, this judgement is academic in nature; it is solely from the perspective of an individual pesticide application, with no contributing factors such as a degraded baseline or additive and synergistic effects from other chemicals. Further, though the use of models represent the best available technology for predicting drift concentrations, the variables that can determine exposure risk (*i.e.*, weather) are likely to be highly variable over the five-year term of the proposed action. Given these factors, there is a reasonable likelihood that runoff concentrations will differ from those predicted and are reasonably likely to lead to adverse effects.

Runoff. The chemical and physical properties of the pesticide such as solubility in water and affinity to soil particles help determine the rate and method of transport. Chemicals that adsorb well to the soil will tend to become immobilized and be broken down in place as opposed to highly soluble chemicals that could be washed away via soil surface or subsurface movement with irrigation or rainwater, and would more likely be a potential contaminant. The soils at Horning are well drained but contain a high amount of organic material and clay, which can adsorb pesticides and retard their movement.

Unintentional transport of pesticides from areas of application to water can be a combined function of many factors. The chemical and physical properties of the pesticide such as solubility in water and affinity to soil particles can determine the rate and method of transport. Chemicals that adsorb well to the soil will tend to immobilize and be broken down in place as opposed to highly soluble chemicals that could be washed away via soil surface or subsurface movement with irrigation or rainwater, and would more likely be a potential contaminant.

Elevated concentrations of pesticides in Milk and Clear Creeks have the potential to occur during irrigation season, which is generally from late May through September. Pesticides are applied during irrigation season, and runoff of excess irrigation water from fields can transport them to surface water. Variations in temporal patterns of elevated pesticide concentrations can also be attributed to a seasonal rise in precipitation during the months of October through April. Significant rain events can increase erosion of soils with absorbed pesticides or flush of the more soluble pesticides.

The BLM assessed runoff and leaching from the proposed action using the GLEAMS and the MOC models. GLEAMS will model the concentration of chemicals that will leave a target field, in this case an orchard block, that is transported by overland flow or that is adsorbed to soil particles transported in the flow by estimation of soil chemical concentrations, initial maximum runoff loadings, and long-term chemical loss in runoff, sediment, and soil below the root zone. The GLEAMS analysis included two scenarios: (1) Typical environmental characteristics and pesticide/fertilizer use; and (2) wet conditions and maximum pesticde/fertilizer use.

The model is not able to predict chemical concentrations reaching streams separated from the target fields by buffer areas. The Horning units generally have significant areas of untreated field edges and well-vegetated buffers between treated acreage and receiving streams. Buffer widths between treated acreage and receiving streams at Horning will typically be in the range of 50 to 100 feet or more. These untreated intervening areas are expected to reduce the amount of chemicals that actually reach streamwater. To account for the attenuating affect of buffer zones, the MOC model developed by the USGS was used.

The uncertainty in the GLEAMS model can be attributed to the model's sensitivity to input parameters that were not directly measured and had to be estimated based on available literature. These parameters include pesticide decay rates, foliar washoff, Koc, and soil curve numbers. The decay rates and foliar washoff factors govern the quantity of the contaminant available for movement, whereas the sorption coefficients and the runoff curve numbers govern the actual movement of the contaminants. The aerial coverage influences the mass of pesticide that reaches the ground from application. Uncertainty in these parameters causes the majority of model uncertainty and exacerbates the risk from exposure.

Table 13 shows a comparison of the exposure profile data (estimated water concentrations from runoff and erosion) specific to Clear and Milk Creeks to stressor-response profile data from attachment C of the BA to estimate the risk of adverse effects. The estimated surface water concentrations are low, several orders of magnitude below the levels of concern. The levels of

concern are determined following the quotient methodology used by EPA's Office of Pesticide Programs (see Sec 9.1 in Horning RA).

Table 13. RA-Modeled Stream Concentrations of Pesticides Under the Proposed Action Resulting from Runoff and Erosion, Effect Concentrations Selected by NOAA Fisheries for Effects Evaluation.

	Milk Creek		Clear Creek		Effect Concentration		
Pesticide	**Typ**	**Max**	**Typ**	**Max**	**LOEC (mg/L)***	**End-point**	**REF**
Aerial (helicopter)							
Esfenvalerate	1.72E-008	1.62E-007	3.40E-008	8.56E-008	2.50E-005	predation	Little et al. 1993
-Ethylbenzene	-0-	1.08E-007	-0-	6.82E-008	14	mortality	Mayer and Ellersieck 1986
- Xylene	-0-	1.04E-008	-0-	6.53E-009	0.1	rearing	Folmar 1976
Airblast sprayer							
Chlorpyrifos	1.66E-008	2.89E-007	1.77E-007	2.86E-007	0.003	mortality	EPA 2000
Esfenvalerate	1.16E-009	5.74E-008	1.13E-008	3.95E-008	2.50E-005	predation	Little et al. 1993
-Ethylbenzene	-0-	3.95E-008	-0-	3.16E-008	14	mortality	Mayer and Ellersieck 1986
- Xylene	-0-	3.79E-009	-0-	3.03E-009	0.1	rearing	Folmar 1976
Permethrin	5.62E-010	9.22E-010	-0-	-0-	7.5E-004	predation	Kumaraguru et al. 1982
-Ethylbenzene	-0-	1.43E-009	-0-	-0-	14	mortality	Mayer and Ellersieck 1986
-Light arom solv naphtha	2.47E-008	1.35E-007	-0-	-0-	0.32	mortality	EPA 2001
-Xylene	-0-	-0-	-0-	-0-	0.1	rearing	Folmar 1976

Pesticide	Milk Creek Typ	Milk Creek Max	Clear Creek Typ	Clear Creek Max	Effect Concentration LOEC (mg/L)*	Effect Concentration End-point	REF
Hand-Held Ground Methods							
Esfenvalerate	-0-	-0-	5.65E-009	2.09E-008	2.50E-005	predation	Little et al. 1993
-Ethylbenzene	-0-	-0-	-0-	1.61E-008	14	mortality	Mayer and Ellersieck 1986
- Xylene	-0-	-0-	-0-	1.54E-009	0.1	rearing	Folmar 1976
Diazinon	-0-	-0-	2.09E-010	9.95E-006	0.001	predation	Scholz et al. 2000
Dimethoate	-0-	5.35E-006	-0-	9.25E-006	1.24	mortality	EPA 1999
-Cyclohexanone	-0-	2.54E-007	-0-	4.39E-007	30.3	mortality	EPA 2001
-Petroleum distillate	2.20E-008	1.54E-006	-0-	2.66E-006	100	mortality	Valent USA 1983
Horticultural Oil	-0-	-0-	5.80E-008	6.47E-006	100	mortality	Valent USA 1983
Propargite	-0-	-0-	3.49E-008	1.15E-007	0.008	mortality	Uniroyal 1998
Picloram	-0-	-0-	-0-	4.05E-011	0.035	growth	Woodward 1976
Chlorothalonil	-0-	-0-	3.68E-009	5.42E-007	0.0049	mortality	Caux et al. 1996
Tractor-pulled spray rig with boom							
Propiconazole	-0-	-0-	2.68E-009	4.12E-008	0.24	mortality	Grande et al. 1994
Glyphosate -strips between rows	-0-	-0-	4.24E-008	1.16E-007	0.046 (NOEC)	migration and growth	Morgan and Kiceniuk 1992
Tractor pulled spreader (general fertilizers)							
NO3	9.57E-004	1.6E-003	5.96E-004	9.42E-004	2	mortality	Rouse et al. 1999
NH4	-0-	4.25E-003	-0-	2.95E-003	0.0074	mortality	Knoph 1992

* Selected LOEC's are for various species of fish and might be less for aquatic macroinvertebrates (relevant to all tables)

** Numerical values represent scientific notation

No risks were predicted from typical conditions of use. From the perspective of viewing each application as a stand-alone event, the likelihood of direct adverse effects to listed salmonids from runoff and erosion are small. The attenuating effects of vegetative buffer zones, the conservative nature of the analysis, conservation practices in place, and the individual modeled concentrations lead to this conclusion. However, as for spray drift, this judgement is academic in nature; it is solely from the perspective of an individual pesticide application, with no contributing factors such as a degraded baseline or additive and synergistic effects from other chemicals. Further, though the use of models represent the best available technology for predicting runoff concentrations, the variables that can determine exposure risk (*i.e.*, weather) are likely to be highly variable over the five-year term of the proposed action. Given these factors, there is a reasonable likelihood that concentrations will differ from those predicted and reasonably likely to lead to adverse effects.

Accidental Spills. The RA addressed spills through the Exposure Analysis Modeling System (EXAMS) model. EXAMS was developed at EPA's Center for Exposure Assessment Modeling at Athens, GA (Burns 2000). Model inputs of half-lives and adsorption coefficients determined the rate and extent of transport of organic chemicals throughout potential spill sites.

A separate EXAMS simulation was performed for each chemical and spill site. They include the mixing area near administrative buildings, Horning Reservoir (irrigation pond), and two orchard roads that cross the tributary to Swagger Creek. Results of the modeling show that maximum residues from spills into the larger perennial streams or intermittent streams at times of significant flow would reach Swagger Creek (a tributary to Clear Creek) or Nate Creek (a tributary to Milk Creek) in lethal concentrations within an hour. Spills near any water will be avoided through siting the mixing and loading zones in the pesticide area, greater than 500 feet from water. These best management practices combined with an adequate spill prevention plan should avoid the scenario of spill delivery of pesticides to surface waters.

Most categories of aquatic species (fish, invertebrates, amphibians, both sensitive and non-sensitive) are at risk from spills of tank mixtures of chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, propargite, chlorothalonil, dicamba, glyphosate, hexazinone, horticultural oil, picloram, and triclopyr butoxyethyl ester into the irrigation pond, or into onsite tributaries to Swagger Creek and Nate Creek. No risks were predicted in any spill scenarios from acephate, propiconazole, glyphosate (Rodeo), or triclopyr triethylamine salt.

No modeling results in the risk analysis quantitatively describe the elevated concentrations of pesticides from spill delivery that steelhead in Clear Creek or Milk Creek would be exposed to. It is safe to assume that modeled elevated pesticide concentrations from spills in Swagger and Nate Creek, tributaries to Clear and Milk creek, would be diluted to some extent before they reach steelhead in Clear Creek or Milk Creek several miles downstream. However, the potential for lethal or sub-lethal effects would be present. Spill mixtures may elicit synergistic or additive effects from the chemicals present in mixture themselves or from combinations of spill chemicals and baseline concentrations.

Summary of Vectors of Exposure. Given Horning's location, subsurface or surface water runoff and delivery to areas occupied by salmonids would likely be limited to spring (zone one) and fall (zone three) periods.

Site conditions at Horning limit the pathways of pesticide and fertilizer exposure to steelhead. Steelhead, coho and spring Chinook, often at multiple lifestages, are expected to be downstream in Milk Creek and Clear Creek throughout the year. In the event of a discharge to Clear or Milk Creeks, it is highly probable that listed salmonids will be in the vicinity of the exposure. However, given Horning's upland location, discharges are likely to be limited to runoff. The distance, and ground-based application methods, to steelhead use within Milk Creek (5 miles) and Clear Creek (1 mile) would likely preclude delivery from drift sources. However, drift delivery to on site intermittent streams and subsequent delivery from surface or subsurface runoff is likely to occur.

Accumulations of Pesticides, Herbicides and Fertilizers in Soil. Impacts from the application of pesticides to soil can be divided into two groups - those occurring from chemicals which are highly mobile in soils and have a high water solubility, and impacts from chemicals with a low mobility in soil (high adsorption rate) and are only slightly soluble in water. High lipophilicity (fat solubility) of the pesticide is the primary driver for non-specific partitioning (sorption) into soil organics. True adsorption (binding to a specific site) also occurs, and positively charged pesticides tend to adsorb to clay particles (clays tend to have negative surface charges). Therefore, some pesticides with high water solubility can be adsorbed by soils with significant clay content.

Most chemicals proposed for application have a low mobility in soil due to a higher rate of adsorption. These chemicals would likely remain near the surface of the soil and degrade over time. Most degradation occurs by microbial metabolism. Other methods of degradation include hydrolysis (the splitting of a molecule by the addition of the elements of water), photolysis (degradation by radiant energy), and chemical degradation. Except the herbicide picloram which has a soil half-life in the five- to six-month range, the soil half-life of most of these chemicals is less than three months.

Three of the pesticides proposed for application at Horning are highly mobile in soil: Dimethoate, dicamba, and picloram. The application of the pesticides would not use a sufficient amount of water to move chemicals past the surface of the soil and the timing of the proposed pesticide considers forecasts for precipitation (an application rate of 50 to 150 gallons per acre of water mixed with the chemical would be equivalent to about 0.02 to 0.05 inches of water applied to the area). Any applied pesticides would likely remain near the surface and begin degrading, until subsequent rainfall or irrigation moves any remaining residues into the soil horizon. Mobile pesticides leaching through the soil column would migrate into groundwater. Photodegradation and metabolism by soil microbes would no longer be viable degradation pathways, and half-lives in groundwater could become substantially longer.

The GLEAMS modeling conducted for the RA indicates that negligible accumulation was expected. The long period of simulation (10 years with application assumed to occur annually) allowed an evaluation of the tendency for a chemical's environmental persistence, if residues remain after one year, to contribute to an increased concentration in runoff or leachate in later years. This conservative assumption is inherent in the stream concentrations estimated to result from any pesticide loss in runoff from treated areas.

Fertilizers. Fertilizers are used to optimize production at Horning. Fertilizers are to be distributed over the ground using a broadcast spreader pulled by a truck or mounted on a tractor or ATV. Several types of fertilizers are proposed for use at Horning: ammonium nitrate, ammonium sulfate monoammonium and diammonium phosphate, calcium nitrate, potassium nitrate, potassium chloride, and potassium sulfate. Most of these fertilizers are very soluble in water and can contribute ammonia and nitrates in runoff to surface waters.

Ammonia in the runoff can exist in its ionized form ($NH4+$), and in its un-ionized form as ammonia ($NH3$). The equilibrium between these two forms is largely dependent on pH and temperature. Un-ionized ammonia is the more toxic form, because it is a neutral molecule and thus is able to diffuse across the epithelial membranes of aquatic organisms much more readily than the charged ammonium ion (EPA 1999). However, the ammonium ion is generally present in much greater concentrations and can also contribute to ammonia toxicity under some conditions. The RA modeling analysis assumed the most conservative situation and considered all of the ammonium in the runoff to be in the more toxic unionized form ($NH3$).

Ammonia is of much concern due to its relatively toxic nature and its ubiquity in water bodies. Ammonia occurs in natural waters secreted by aquatic plants and animals, and generated by heterotrophic bacteria as the primary end product of decomposition of organic matter (Randall and Tsui 2002). As aquatic plants and animals die, bacteria break down large protein molecules containing nitrogen into ammonia. Ammonia is then oxidized by specialized bacteria to form nitrites and nitrates.

Concentrations of ammonia acutely toxic to fishes may cause loss of equilibrium, hyper-excitability, increased breathing, cardiac output and oxygen uptake (EPA 1986). In extreme cases, damage to the central nervous system from acute levels can lead to convulsions, coma, and death (Randal and Tsui 2002). Other mechanisms of ammonia toxicity were outlined by Ruffier *et al.* (1981) to include gill damage leading to suffocation, osmoregulation dysfunction (bloating) causing kidney failure, and inhibition of ammonia excretion leading to neurological and cytological failure.

At lower concentrations, ammonia has many sublethal effects on fishes, including a reduction in hatching success, increased respiratory distress, hormonal dysfunction, reduction in growth rate and morphological development (Rice and Bailey 1980; Soderberg *et al.,* 1983; EPA 1986; EPA 1999). The literature also contains some information concerning the effects that chronic exposure to low levels of ammonia can have on the structure and function of select tissues and organs such as gills, livers, and kidneys and their increased susceptibility to disease (Soderberg

et al., 1983; EPA 1986; EPA 1999). Behavioral effects to chronic levels of ammonia are reduced swimming stamina and performance which would affect predator avoidance and foraging behaviors (EPA 1999).

The proposed action would preclude fertilizers within 50 feet of waterways as a measure to reduce delivery to aquatic systems. This distance would act as a preventative measure to reduce runoff to surface water as the additional ground will sorb fertilizer compounds.

Water Quality Factors Which Alter Susceptibility to Toxic Pesticides and Fertilizers. The combination of heat and other stress factors can compromise salmonid immune system function (Hardie *et al.*, 1994; Kollner and Kotterba 2002; McCullough 1999), putting them at an increased susceptibility to disease. Likewise, exposure to environmental pollutants can decrease tolerance to temperature extremes (Paladino *et al.*, 1980). Sub-cellular and molecular changes such as enzyme induction are known to precede observable individual or population level effects (Boon *et al.*, 1992).

As previously discussed, many factors in the Mollala and Clackamas Watersheds contribute to elevated stream temperatures in waterways that host listed salmonids in the action area. Glyphosate toxicity to rainbow trout increases with higher test temperatures (Folmar *et al.,* 1979). Toxicity also increased from pH 6.5 to 7.5, but did not change up to pH 9.5. Increasing temperature and pH with exposures to picloram resulted in greater toxicities to cutthroat trout and lake trout (Woodward 1976). Rainbow trout became more sensitive to permethrin with increasing water temperature (Kumaraguru and Beamish 1986). The 96-hour LC50 values decreased by nearly an order of magnitude (0.0064 to 0.00069 mg/L) between 10 and 20˚C, respectively.

Higher temperatures can also shift the equilibrium of ammonia species to its more toxic un-ionized form. The concentration of un-ionized ammonia present in an ammonia solution has been calculated to double in a 10˚C rise in temperature (Ruffier *et al.,* 1981). While the effects of temperature on the mechanism of ammonia toxicity is not well understood, the increased bio-availability to the more toxic unionized ammonia can increase the risk of fertilizers to salmonids.

Mixture Toxicity. Aquatic organisms can be exposed to complex mixtures of contaminants resulting from pollution that originates from industrial, agricultural, and domestic land use. Eco-toxicological studies that assess the effects of contaminants to aquatic communities typically have been limited to assessing the impacts of individual toxicants only. However, discrete assessments of individual toxicants do not capture the true exposure routes and effects to species which occupy habitat that is subject to multiple temporal and spatial chemical discharge. For salmonids, who occupy diverse habitat types throughout each life history stage, exposure to chemical mixtures can occur within the water column, and from contaminated sediments and food. Given these complexities, consideration must be given to the potential that a wide variety of chemicals might be simultaneously present in complex mixtures. Furthermore, these mixtures of chemicals likely contribute to reduced productivity of some aquatic ecosystems. For instance, Arkoosh *et al.*, (1991) found that juvenile Chinook salmon

that migrated through waters contaminated with PCBs and PAHs, and heavily influenced by an urban landscape, bioacccumulated the pollutants, and showed signs of suppressed immune responses compared to uncontaminated fish. Casillas *et al.,* (1993) found that juvenile Chinook in urban waters showed suppressed immune function, reduced survival, and impaired growth as they migrated to the oceanic environment. More recently, a pilot study by the NWFSC revealed significant pre-spawn mortality of coho salmon within a highly urbanized watershed within the City of Seattle, as compared to a relatively non-urbanized stream within the Stillaguamish River Watershed. It is thought that pollutant mixtures delivered to the urbanized watershed through contaminated stormwater contributed to the high level of pre-spawn mortality, though the exact causes of mortality have not been fully determined to date.

Multiple chemicals that co-occur in aquatic systems may alter their toxicity by additive, antagonistic, or greater than additive (synergistic) effects (Denton *et al.,* 2002). An additive effect occurs when the combined effect of several chemicals is equal to the sum of individual effects of each chemical as if they were alone (Klassen 1986). Antagonistic effect occurs when a mixture contains chemicals that interfere with each other's actions, or with the action of the other chemical. A greater than additive (synergistic) effect occurs when the combined effect of two chemicals is much greater than the sum of the effect of each agent individually (Klassen 1986). A special form of synergism is potentiation, which occurs when one substance has no toxic effect in and of itself, but when added to another chemical it enhances the toxicity of the toxic component (Klassen 1986).

Predicting Mixture Toxicity. It is necessary to examine the interactions or non-interactions of toxicants when characterizing and predicting the risk of chemical mixtures to listed salmonids. Predictive assessments of the aquatic toxicity of chemical mixtures are represented by numerous methods and models that are presented in several fields of pharmacology and toxicology (Faust 2003). In essence, however, there are two different fundamental hypotheses on the functional relationship between the toxicity of single substances and those of combined toxicants (Faust 2003). Commonly, those hypotheses are called concentration addition and response addition.

The concentration addition model best describes the scenario of non-interactive joint-action and is generally applied to chemicals that exhibit a similar mode of action. The individual components of a mixture act independently but produce the same or similar effects and can be expressed in terms of the other (Broderius *et al.* 1995). For example, the joint toxicity of diazinon and chlorpyrifos on *Ceriodaphnia dubia* was examined in a study by Bailey *et al.* (1997). The toxic interaction was evaluated by a Toxic Unit approach that compared the LC50 estimates associated with the mixtures with the LC50s of the individual pesticides when tested alone. The results suggested that diazinon and chloryprifos exert additive toxicity to *Ceriodaphnia dubia.* This is entirely reasonable given that both are metabolically activated organophosphorus pesticides and act similarly with respect to the inhibition of acetlycholinesterase (Bailey *et al.* 1997). The toxicity of s-triazine mixtures, herbicides that commonly interfere with photosynthetic electron transport, are found to also be accurately predicted by the concept of concentration addition (Faust *et al.* 2001). The study further

demonstrated that low concentrations of individual triazines, that alone did not cause a statistically significant response, contribute predictably to the overall effects of multi-component mixtures. For an assessment of mixtures which have a common specific mechanism of action, these studies show that an assessment of mixtures solely by independent components can tend to underestimate its overall toxicity.

As an alternative concept to concentration addition, mixtures of chemicals composed of dissimilar toxicants with varying modes of action, can be analyzed via the response-addition model, for predicting toxicity (Faust 2001). These models are based on the assumption that each toxicant neither enhances or interferes with the other and contributes to a common response only if the concentrations of both substances exceed their respective thresholds (Broderius *et al.* 1995). In this case, the toxicity of a mixture is equal to the that of its most toxic component (Sharma *et al.* 1999) and that the relative effect of a toxicant remains unchanged in the presence of another chemical (Faust *et al.* 2001). This approach has been demonstrated to provide accurate predictions of single species toxicity when all underlying assumptions are fulfilled.

Faust *et al.* (2003) studied the situation of multiple exposures to biocides with strictly different specific mechanisms of action to freshwater algae. Both concepts of concentration addition and response addition was applied to predict mixture toxicity. The concentration addition approach tended to overestimate mixture toxicity showing that the response addition approach proved to be superior when mixture components are well known to interact specifically with different molecular target sites.

However, developing scientific research indicates that simple concentration addition and response addition models are not always good predictors of the toxicity of mixtures. In many cases the effects of mixtures cannot be predicted from single components. Pape-Lindstrom and Lydy (1997) demonstrated that the response addition model does not always accurately predict the mixture toxicity of chemicals with dissimilar modes of action. In their experimental design, larvae of the aquatic midge (*Chironomus tendons*) were exposed to binary combinations of atrazine and various organophosphate insecticides. Their results conclusively show a greater than additive response for several combinations of chemicals that have dissimilar modes of action. Mixtures that result in greater than additive (synergistic) toxicity are of much concern due to unpredictability based on the effect of individual components (Woods *et al.* 2002).

The complex interactions that result from a mixture are generally between the chemicals and the physiological systems within the body, rather than between the chemicals themselves (Marking 1985). Examples of such interactions are the alteration of the absorption, distribution, biotransformation, or excretion of one chemical by another. There are two currently recognized mechanisms of greater than additive (synergistic) toxicity that involve such interactions, the increase in enzymatic activation of the other pesticide and the inhibition of enzymes responsible for detoxification (Woods *et al.* 2002).

In the metabolism of an organic pesticide, enzymatic activity induces a series of chemical alterations, in a process called biotransformation. The process of biotransformation can be

divided into 'phase I' and 'phase II' metabolism. The first involves a change in the molecular structure of a pesticide by involving either hydrolysis, oxidation, or reduction (Sipes and Gandolfi 1986). Phase II biotransformation involves the conjugation of a substrate to endogenous pesticides (Boon *et al.* 1992). The end result of these reactions is that the metabolites are chemically distinct from their parent pesticide. Metabolites are usually more hydrophilic than their parent pesticide which restricts the partitioning of metabolites into cellular membranes, decreases reabsorption and facilitates eventual elimination (Sipes and Gandolfi 1986). The ease of which pesticides are eliminated depends on their water solubility. This explains why lipophilic pesticides, like dioxins, are readily absorbed, poorly excreted, and have a tendency to accumulate.

However, it is important to note that biotransformation can result in higher toxicity (Boon *et al.* 1992). For example, several organophosphorus insecticides such as chlorpyrifos, methyl-parathion, and malathion are in of themselves poor inhibitors of acetylcholinesterase. However, upon phase I metabolic conversion, their corresponding oxygen analogs are highly potent acetylcholinesterase inhibitors. The rate of metabolic activation to a pesticide of higher toxicity can be increased by the presence of other chemicals in a mixture (Woods *et al.* 2002). This can help explain the greater than additive toxicity noted for combinations of organophosphorus insecticides and other pesticides.

Inhibition of enzymes that are responsible for detoxification will result in increased levels of active pesticide to interact with target sites (Woods *et al.* 2002). Carboxylesterases are an important class of serine hydrolases that cleave esters into the corresponding alcohol and acid. They can serve an important function by detoxifying pyrethroids and other ester containing pesticides such as herbicides (Denton *et al.* 2002). However, carboxylesterases can be inhibited by organophosphates and carbamates. Mixtures of organophosphates and pyrethroids could potentially exhibit a synergistic toxicity. Denton *et al.* (2002) examined joint mixture toxicity of diazinon and esfenvalerate to fathead minnows. The observed greater than additive (synergistic) toxicity was attributed to inhibition of carboxylesterase activity by diazinon, a potent organophosphate.

Horning Mixture Analysis. The concept of concentration addition has been used to quantitatively analyze the effect of simultaneous exposure of pesticides to salmonids from pesticide application at Horning. Additive action is the most common form of mixture toxicity (Marking 1985), and would be very relevant considering the type of pesticides used at Horning. Greater than additive or less than additive interactions would be exceptions and are difficult to predict.

Concentration addition is expressed mathematically as:

$$\sum_{i-1}^{n} \frac{c_i}{ECx_i} = 1$$

For a multi-component mixture of n substances: ci is the concentration of the individual substances present in a mixture or dose, ECxi is the equivalent effect concentrations of the individual substance. The equivalent effect concentrations must be similar in the respect of the assessment endpoint for this approach to hold scientific relevance. The quotients resulting from ci/ECxi would then represent the concentrations of individual mixture components as fractions of equitoxic concentrations scaled for its relative potency, TU (toxic unit). By summing the toxic units, the toxic strength of a mixture of pesticides may be determined.

For example, assume a chemical mixture of pesticide A and B with similar modes of toxic action occurs. The known environmental concentration or dose of A, is divided by the toxicity of A (LC50 or other relevant endpoint), which will result in a unitless fractional toxic unit for A. The same procedure is followed for each component in the mixture. The summation of toxic units A and B carries a result that approaches 1. If 1 is reached, then it can be assumed that there is additive toxicity on the acute level.[14]

Concentration addition implies that every toxicant in any concentration contributes, more or less, to the overall toxicity of a mixture, and holds the assumption that the chemicals in a mixture exhibit a similar mode of action. There are two major pesticide groups proposed for use in Horning that fulfill these requirements. The organophosphate insecticide group: acephate, diazinon, chlorpyrifos, and dimethoate, all act similarly in the inhibition of acetylcholinesterase, and the pyrethroid insecticide group: esfenvalerate and permethrin, which act similarly in the blocking of neural voltage activated sodium/calcium channels. For the purpose of this analysis it is assumed that these groups of pesticides would be simultaneously present in salmonid habitat at modeled concentrations from erosion, runoff, and drift.[15] Traditionally, each pesticide group would undergo a separate analysis. In the BLM BA, these pesticides were analyzed individually without consideration to the overall toxicity of a mixture.

Within this analysis, the toxic unit approach described above was used to assess the groups of similarly acting pesticides (organophosphates and pyrethroids) in a specific waterbody using the maximum BLM modeled concentrations due to drift, runoff, and erosion. For instance, as seen in Table 2, esfenvalerate is proposed to be applied within the March through August period annually, using high-pressure hydraulic sprayer, aerially (helicopter), airblast sprayer high-pressure hydraulic sprayer, hydraulic sprayer with hand-held wand, or backpack sprayer.

The BLM modeled estimates of water concentrations from each application type from drift and runoff were then summed. This summation is not unrealistic, because during most of the application window precipitation levels are low relative to other periods, and generally continue to decrease per month, thus reducing the likelihood of runoff delivery facilitated by individual rain events, and individual applications. As such, most delivery to the drainages of Horning of

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[14] Acute mortality data (LC50s) were used as the equivalent effect concentrations of the individual substances. Sublethal or LOEC data can also be used if available.

[15] The highest concentrations in these streams were identified (Table 8-1 in the BA), and can be considered to represent 24-hour average concentrations.

esfenvalerate applied from April through June could occur in zone three (September through December) when precipitation increases and overland flow is more likely. Summation of these individual model results is logical and represents a hypothesis of plausible exposure concentrations to listed salmonids within the listed waterways.[16]

The equivalent effect concentrations of the individual substances were taken from the scientific literature pertaining to the assessment endpoint in question. As depicted in Table 14, after a toxic unit was calculated for each model concentration, they were summed up to give a final toxic unit. As mentioned before, as the final toxic unit approaches one, we can expect acute effects.

Table 14. Mixture toxicity for fish species within receiving waterways

CHEMICAL	APP METHOD	Milk Creek (mg/L)		Clear Creek (mg/L)
Organophosphate group				
Acephate	HPHS & HHW runoff&erosion	0		0
Chlorpyrifos	AIRBLAST runoff&erosion	5.53e-06		5.90e-05
	AIRBLAST Drift	5.87e-05		1.30e-03
Diazinon	HPHS runoff&erosion	0		0
Dimethoate	HPHS runoff&erosion	0		0
	TU total summation	**6.42e-05**		**1.36e-03**
Pyrethroid group				
Esfenvalerate	AERIAL runoff&erosion	1.95e-04		3.86e-04
	AIRBLAST runoff&erosion	1.32e-05		1.28e-04
	HPHS,HHW&BP runoff&erosion	0		6.42e-05
	AIRBLAST Drift	9.98e-05		2.55e-03
	AERIAL drift	2.78e-03		3.86e-03
Permethrin	AIRBLAST & HPHS runoff&erosion	1.94e-07	*	0
	AIRBLAST drift	8.66e-05	*	0
	TU total summation	**3.09e-03**		**6.99e-03**

* Permethrin and Esfenvalerate will not be used in the same year. Note that in this case, only the values given for Esfenvalerate are summed, reflecting the worst case scenario.
** Numerical values are in scientific notation.

Referring to Table 14, the final toxic units for organophosphates and pyrethroids within Milk Creek and Clear Creek are extremely low, several orders of magnitude below where we expect

[16] Note that chemical degradation, or binding to soils, may dilute concentrations or delay delivery to surface waters.

there to be an acute effect to fish species. However as recognized in the environmental baseline, additional pesticides outside of this analysis are likely to increase mixture toxicity reported in this table.

Table 15. Mixture toxicity for macroinvertebrates within receiving waterways

CHEMICAL	APP METHOD	Milk Creek (mg/L)		Clear Creek (mg/L)
Organophosphate group				
Acephate	HPHS & HHW runoff&erosion	0		0
Chlorpyrifos	AIRBLAST runoff&erosion	1.66e-04		1.77e-03
	AIRBLAST Drift	1.76e-03		3.90e-02
Diazinon	HPHS runoff&erosion	0		0
Dimethoate	HPHS runoff&erosion	0		0
	TU total summation	**1.93e-03**		**4.08e-02**
Pyrethroid group				
Esfenvalerate	AERIAL runoff&erosion	5.73e-04		1.13e-03
	AIRBLAST runoff&erosion	3.87e-05		3.77e-04
	HPHS,HHW&BP runoff&erosion	0		1.88e-04
	AIRBLAST Drift	2.93e-04		7.47e-03
	AERIAL drift	8.17e-03		1.13e-02
Permethrin	AIRBLAST & HPHS runoff&erosion	1.44e-06	*	0
	AIRBLAST drift	6.44e-04	*	0
	TU total summation	**9.07e-03**		**2.05e-02**

* Permethrin and Esfenvalerate will not be used in the same year. Note that in this case, only the values given for Esfenvalerate are summed, reflecting the worst case scenario.
** Numerical values are in scientific notation.

Macroinvertebrates are generally more sensitive to pesticides than salmonids. We would expect to see similar toxic effects as before but magnified. Referring to Table 15, the final toxic units for pyrethroids and organophosphates within Milk Creek and Clear Creek are very low, outside of where we would expect to see adverse effects on the acute level, but are almost an order of magnitude greater than the values we observed in Table 14 for salmonids.

<u>**Prey Base Effects and Bioaccumulation**</u>. It is becoming increasingly evident that the indirect effects of contaminants on ecosystem structure and function are a key factor in

determining a toxicant's cumulative risk to aquatic organisms (Preston, 2002). As mentioned within the analysis of the family of pesticide above (as applicable), adverse effect to salmonid prey base can occur from exposure to some substances. Moreover, aquatic plants and macroinvertebrates are generally more sensitive than fish to the acutely toxic effects of herbicides. Therefore, chemicals can potentially impact the structure of aquatic communities at concentrations that fall below the threshold for direct biological impairment in salmon. The integrity of the aquatic food chain is an essential biological requirement for salmon and steelhead, and the reasonable likelihood herbicide applications will reduce the productivity of streams and rivers is a significant adverse effect.

Pesticide, herbicide and fertilizer effects to salmonid prey base typically occur through two primary mechanisms: effects to the amount and/or type of food supply, or by pesticide exposure via food organisms. Depending on the exposure scenario, effects to aquatic invertebrate communities can be very short-term, or take months or years to fully recover. Pesticide exposure via food organisms is likely to be much more episodic and short-term. Norris *et al.* (1991) provide a summary and literature review of pesticide and fertilizer effects to salmonids. The amount and/or type of food supply can be altered by pesticides and fertilizers in complex and subtle ways, particularly if the aquatic system is exposed to a combination of insecticides, herbicides, and fertilizers.

Insecticides can alter the prey base by direct mortality of aquatic invertebrates. Insecticides are typically more toxic to fish and other aquatic organisms than herbicides, but are generally applied at lower rates (Beschta *et al.*, 1995). Insecticides can cause direct mortality of aquatic invertebrates, or trigger extensive drift of aquatic invertebrates out of the affected area (Spence et al, 1996). If grazing invertebrates are reduced or eliminated from a stream reach, primary production release may occur (such as algal blooms), altering trophic structure.

Herbicides are often not highly toxic to salmonids, as they are generally designed to interfere with physiological systems unique to plants. However, low concentrations of herbicides may exert significant effects on salmonid prey items by affecting algal or aquatic plant communities (Pratt *et al.*, 1997), or directly on salmonids through sub-lethal effects of the herbicide (Spence *et al.*, 1996). In addition, some herbicides are moderate to highly toxic to aquatic invertebrates, such as triclopyr ester (SERA, 2003b), and adjuvants and surfactants present in herbicide commercial formulations can greatly enhance toxicity (Stark and Walthall, 2003, SERA, 1997). Fertilizers can also affect salmonid food supply by increasing algal and other aquatic plant growth, altering the aquatic invertebrate community.

Salmonid pesticide exposure through food organisms can occur through incidental exposure of terrestrial insects which subsequently become prey items for fish (Norris *et al.*, 1991), or indirectly through invertebrate ingestion of organic material delivered to the aquatic system (Urban and Cook, 1986). Pesticides which are more lipophilic (fat soluble) will tend to partition into organic material in or on soil. Runoff can mobilize organic material into streams where it is consumed by insects and crustaceans. Little data is available on the risk of exposure via this

pathway, but risk is likely to be highly variable depending on conditions at the time of application, such as seasonal timing.

Bioaccumulation in fish is partially mediated by the presence of insecticides and herbicides in food items and sediment residues, but also includes bioconcentration, defined as passive uptake from the water column (Klaassen *et al.*, 1986). The lipophilicity of the pesticide and fat content of the organism are the primary factors determining the extent of bioaccumulation. Pesticides with high lipophilicity tend to partition out of the water column and into food items, with the degree of partitioning proportional to the organism fat content. Concentration up the food chain (biomagnification) occurs when repeated exposure through consumption of contaminated prey items results in high concentrations of pesticide in predators, such as salmonids. In order for bioaccumulation to occur, a pesticide must have sufficient lipophilicity and persistence, and relatively low acute toxicity. Within the BA, the potential for bioaccumulation of degradates and metabolites is not addressed.

The possibility of adverse effects from additive, antagonistic or synergistic effects from multiple applications exist. The relative risk of these type of adverse effects depends upon the volume and timing of their delivery, and background water quality conditions. Within the zones of possible exposure periods described above, the greatest likelihood of additive/synergistic effects from applications would occur anytime precipitation events cause significant subsurface or overland flow delivery to aquatic systems. The volume and types of pesticides delivered would depend upon the relative success of CPs to inhibit off-target delivery. At Horning, it is thought that the greatest potential for this pathway of adverse effects would occur in zone two (May through September) and zone three (October though December). As precipitation levels rise, subsurface and overland flow off Horning will increase, thus pesticide delivery to Milk and Clear Creeks is reasonably likely to occur. As previously mentioned, model results are derived from a number of conservative assumptions, and NOAA Fisheries utilized the maximum application rate scenario, and the application frequency listed in Table 2.

<u>**Cultural, Biological, and Physical Methods**</u>. The cultural, biological, and physical pest treatments are unlikely to have measurable effects, due to the small amount of area where these treatments would be applied, and the very limited amount of disturbance to riparian soils and native vegetation communities the treatments are expected to create. Cultural and biological controls have very little potential to effect salmonids or their habitat. Cultural controls are preventive measures to reduce the risk of introduction or dissemination of weeds. They do not involve ground disturbing activities. Biological controls use insects and pathogens determined to be host-specific, highly damaging to targeted species, able to survive in the host's habitat, free of natural parasites, and not likely to be parasitized in the host plant's habitat. Biological controls pose no foreseeable risk to salmonids or their habitat. Physical controls involve ground disturbing activities (pulling or cutting of weeds). However, the scope and magnitude of this action is so limited that any effect to salmonids or their habitat is considered negligible. The use of prescribed burns is limited to non-riparian areas. Provided that proper treatment methods (*i.e.*, burn containment and timing) are used, there would be very little potential for adverse effects.

Establishment of Monitoring Criteria. The following pesticides proposed for use at Horning (Table 16) posed the largest threat to aquatic organisms and habitat. The close monitoring of these contaminants is necessary in order monitor the effectiveness of Conservation Practices and the Terms and Conditions of this Opinion.

Low and high triggers for reinitiation were established by considering LC50 values taken from the scientific literature, and dividing by 20 to create a 'low trigger', and 2 to create a 'high trigger.'

The low trigger reflects a conservation measure that attempts to reduce, though not avoid, sublethal effects in coho salmon. A high trigger reflects a concentration in which direct mortalities may occur which is not authorized in this Opinion. The low trigger levels are those estimated dissolved contaminant concentrations in water, which can be surpassed a single time, for one compound, during each of the three annual precipitation and application zones as displayed within the Opinion (Figure 2 and Table 11). Thus, a total of three annual exceedences of the low trigger are allowed per year, one during each period.

A high trigger reflects a concentration in which direct mortalities may occur which is not authorized in this Opinion. The high trigger values are those dissolved contaminant concentrations in flowing water at which acute lethality may occur. Meeting or exceeding these concentrations would require re-initiation of consultation.

The literature sources were agreed upon by NOAA and BLM and previously used by the BLM in an extensive effects analysis section of the BA. Detection limits of pesticides are also given if known. The low trigger and high trigger values may be revisited (and potentially revised) annually to incorporate new data regarding baseline conditions, and newly-published sublethal effects.

Table 16. Monitoring triggers

Compound	Chemical Family	LC50 (PPB)	'low trigger'	'high trigger'	Detection Limit	LC50 Source
Chlorpyrifos	Organo-phosphate	3	0.15	1.5	0.04	EPA 1984
Dimethoate		6200	310	3100	0.8	EPA 1999
Diazinon		90	4.5	45	0.2	Johnson & Finley 1980
Permethrin	Pyrethroids	7	0.4	3.5	0.4	Holcombe *et al.* 1982
Esfenvalerate		0.09	0.0005	0.045	0.02	Curtis *et al.*, 1985
Propargite	Organo-sulfite	118	5.9	59	0.4	EPA 2000

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Compound	Chemical Family	LC50 (PPB)	'low trigger'	'high trigger'	Detection Limit	LC50 Source
Trichloropyridnol (Triclopyr and chlorpyrifos degradate) picloram[17]	Pyridine derivatives	1500	75	750	NA	Wan 1988
Chlorothanil	Chlorinated-benzene nitrile	42	2.1	21	0.04	EPA 1999

Semi-Permeable Membrane Devices (SPMDs). SPMDs shall be deployed to monitor instream waterborne concentrations of pesticide contaminats. The SPMD is an instream 'accumulator' which allows calculation of an average chemical concentration during the period of deployment.

SPMDs provide a time-weighted average concentration for the chemicals of interest and only measure the dissolved and, therefore, the readily bioavailable fraction. The contaminants of highest concern (pyrethroids and organophosphates) are highly hydrophobic and exhibit high Koc-binding affinities. These contaminants are likely to bind to available particulate organic carbon and ultimately move as particles in marine, freshwater, and estuarine ecosystems. Thus, the SPMD data will capture only a small fraction of these contaminants that actually enters the waterbody. Contaminants sequestered by particulate organic carbon are not sampled and are still available to enter food webs, or play significant roles in habitat forming processes. However, SPMDs successfully monitor the dissolved waterborne concentrations of contaminants that are immediately bioavailable to ESA-listed species. Thus, they are a reliable source of information on the effectiveness of conservation practices to reduce exposure and eliminate any chance of acute mortalities.

Cumulative Effects

Cumulative effects are defined in 50 C.F.R. 402.02 as 'those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation.' Other activities within the watershed have the potential to impact fish and habitat within the action area. Future Federal actions, including the ongoing operation of hydropower systems, hatcheries, fisheries, and certain land management activities are being (or have been) reviewed through separate section 7 consultation processes with a variety of Federal action agencies.

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[17] Trichloropyridnol (TCP) is a degradate of both chlorpyrifos and Triclopyr, that is classified as moderately toxic to fish. As a moderately toxic, common degradate of two of the pesticides applied, with a half-life ranging from 12 - 229 days, TCP poses a risk to listed salmonids greater than or equal to some of the pesticides applied. Therefore, TCP was added to the list of compounds to be monitored.

Within this Opinion, cumulative effects have been analyzed from the context of future pesticide use and pollutant discharge (and other water quality degradation) to surface waters from non-Federal land use. Such land uses include urban and suburban, commercial forestry and agriculture.

While general land use is known, details of pesticide and fertilizer application amounts and acres treated are not well documented for the Clackamas or the Molalla Basin. However, the prevailing land uses within the Clackamas River, and to a lesser extent the Molalla River as well, combined with past water quality monitoring (USGS 2003) lead to a deduction that there is a reasonably high likelihood of future pollutants entering aquatic systems in the action area; specifically Milk Creek and the Molalla River, as well as Clear Creek and the lower Clackamas River. The most relevant data for pesticide application rates for various crops grown near Horning is found within Jenkins (1999), as displayed in Table 17.

Table 17. Lower Willamette River agriculture and associated chemical use, illustrated by pounds of Active Ingredient (a.i.)

		TOTAL PLANTED ACRES:	**93708**		
PESTICIDE	**(lbs. a.i.)**	**PESTICIDE**	**(lbs. a.i.)**	**PESTICIDE**	**(lbs. a.i.)**
1,3-DICHLOROPROPENE	10000	DIQUAT	32	MONOCARBAMIDE	858
2,4-D	2280	DISULFOTON	382	MYCLOBUTANIL	55
2,4-DB	264	DIURON	47268	NALED	6348
ACEPHATE	4350	DODEMORPH ACETATE	50	NAPROPAMIDE	15740
ALACHLOR	2271	DODINE	1342	NORFLURAZON	1621
ASULAM	28	ENDOSULFAN	4763	OIL	18859
ATRAZINE	7186	EPTC	20210	ORYZALIN	2720
AZINPHOS-METHYL	4273	ESFENVALERATE	402	OXADIAZON	4990
B. T.	3260	ETHALFLURALIN	90	OXYCARBOXIN	50
BACILLUS SUBTILLIS	24	ETHEPHON	137	OXYDEMETON-METHYL	1386
BENDIOCARB	1650	ETHOFUMESATE	316	OXYFLUORFEN	5347
BENEFIN	350	ETHOPROP	3640	OXYTHIOQUINOX	717
BENOMYL	5934	ETRIDAZOLE	135	PARAQUAT	8793
BENSULIDE	506	FENAMIPHOS	3108	PARATHION	20
BENTAZON	576	FENARIMOL	15	PCNB	520
BIFENTHRIN	3895	FENBUTATIN-OXIDE	3509	PENDIMETHALIN	2012
BORDEAUX	4523	FENPROPATHRIN	10	PERMETHRIN	1068
BROMINE	30	FENVALERATE	19	PHORATE	546
BROMOXYNIL	4408	FERBAM	786	PHOSMET	497

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PESTICIDE	(lbs. a.i.)	PESTICIDE	(lbs. a.i.)	PESTICIDE	(lbs. a.i.)
BUTYLATE	216	FLUVALINATE	12	PRONAMIDE	10318
CAPTAN	5074	FONOFOS	4935	PROPARGITE	1212
CARBARYL	3515	FORMETANATE HCl	35	PROPICONAZOLE	3384
CARBOFURAN	1970	FOSETYL-AL	225	PYRETHRINS	50
CARBOXIN	919	GLYPHOSATE	5601	RESMETHRIN	10
CHLORAMBEN	137	HEXAZINONE	1300	SETHOXYDIM	431
CHLORINE	20	IMAZALIL	10	SIMAZINE	9366
CHLOROPICRIN	9838	IPRODIONE	4192	STREPTOMYCIN	200
CHLOROTHALONIL	7153	ISOXABEN	715	SULFUR	11092
CHLORPYRIFOS	14614	KINOPRENE	10	TERBACIL	501
CHLORPYRIFOS-METHYL	735	LACTOFEN	62	THIOBENDAZOLE	100
CHLORSULFURON	36	LIME SULFUR	16140	THIOPHANATE-METHYL	1203
CIPC	604	MALATHION	3003	THIRAM	1298
CLOPYRALID	135	MALEIC HYDRAZIDE	933	TRIADIMEFON	315
COPPER	58212	MANCOZEB	3077	TRIADIMENOL	197
COPPER + LIME	1500	MANEB	2434	TRIALLATE	11727
DCPA	1870	MCPA	19880	TRIBENURON	185
DIAZINON	3796	METALAXYL	1838	TRICHLORFON	11500
DICAMBA	2461	METALDEHYDE	3012	TRIFLUMIZOLE	65
DICHLOBENIL	2975	METAM SODIUM	1040	TRIFLURALIN	1889
DICLOFOP	12165	METHAMIDOPHOS	10	TRIFORINE	153
DICOFOL	1004	METHOMYL	57	TURBUFOS	46
DIENOCHLOR	130	METHOXYCHLOR	38	VERNOLATE	392
DIFENZOQUAT	1344	METHYL BROMIDE	33165	VINCLOZOLIN	5794
DIMETHOATE	1064	METOLACHLOR	6093	ZIRAM	160
DINOCAP	350	METRIBUZIN	4402		
DIPHENAMID	889	MEVINPHOS	97	Jenkins 1999	

As listed in the Environmental Baseline section of this Opinion, numerous pesticides have been detected in the lower Clackamas River. For example, the USGS detected concentrations of atrazine during storm runoff events in May and October 2000 within the Clear Creek Watershed. Other potent herbicides, (deethylatrazine, pendimethalin, and triclopyr) were also detected. Clear Creek contributed 4% of the lower Clackamas pesticide load in May 2000, and 2% in October 2000. The discharge of these and other pesticides, while not necessarily the same kinds used by the BLM at Horning, contribute to an elevated pollutant level that may underestimate the

risk to listed salmonids. Interactions with these chemicals and known organophosphate pesticide releases further exacerbate the risks. The pesticide application data as summarized in Table 16 may be roughly representative of application within the Molalla and Clackamas Basin as well. The relative pathways of effects to salmonids are similar to the Mixture Toxicity section above.

Background concentrations of pesticides from non-BLM applications are reasonably certain to persist over time. However, the recent U.S. District Court for the Western District of Washington decision that require buffers for certain pesticides and streams could reduce the volumes and types of cumulative (non-BLM) discharges that occur in the action area, although the degree of improvement would be difficult to determine.

NOAA Fisheries believes that baseline conditions within much of the action area will be subject to local changes in the short and long term. NOAA Fisheries assumes that future private and state actions will continue at similar intensities as in recent years.

Conclusion

After reviewing the best available scientific and commercial information regarding the biological requirements and the status of the listed salmonid ESUs considered in this Opinion, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, NOAA Fisheries' concludes that the action, as proposed, is not likely to jeopardize the continued existence of these species.

These conclusions are based on the following considerations: (1) The BLM will use integrated pest management to ensure that a combination of all available pest control strategies, including pesticide alternatives, are applied to keep pests below treatment thresholds while reducing the need for pesticide applications; (2) when pesticide use is required, BLM will select the pesticide formula that is least toxic for fish and aquatic life while achieving management needs; (3) the application of pesticides will be timed to coincide with weather conditions that are least likely to result in riparian and aquatic contamination; (4) broad, non-spray buffers will be observed to reduce the likelihood of significant quantities of pesticide will be transported to riparian and aquatic systems through aerial drift, surface runoff, and groundwater runoff; (5) pesticides will be applied using precise methods designed to reduce the amount of pesticide loss; (6) a comprehensive sampling, monitoring, and analysis protocol will be used to ensure that the behavior and transport of pesticides in the environment are as predicted; (7) the proposed action includes an explicit process to quickly modify the proposed action based on any significant new information that may be developed through consultations now underway with the EPA regarding the effects of pesticides proposed for use during management of Horning Seed Orchard; and (8) all fertilizer applications will be applied at environmentally optimum rates designed to reduce the presence of fertilizer products in drainage water delivered to surface and groundwater systems.

Conservation Recommendations

Section 7 (a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of habitats, or to develop additional information. NOAA Fisheries believes the following conservation recommendations are consistent with these obligations, and therefore should be carried out by the BLM. Information from the proposed recommendations will help to reduce uncertainty about the effects of past and ongoing human and natural factors leading to the status of listed salmon, their habitats, and the aquatic ecosystem within the action area.

- The BLM should conduct or fund additional monitoring of the Clear Creek and Milk Creek Watersheds for toxic pesticides including sediment sampling. Certain classes of pesticides and herbicides within the proposed action exhibit an affinity for binding to organic carbon molecules and are readily taken up in the sediments. Particulate bound contaminants can still be available to enter freshwater food webs and provide a different exposure pathway for salmonids. The sediment sampling should occur within receiving waterways and near sources of known discharges. This data would assist in future ESA analysis for similar proposed IPM actions, and provide meaningful data for adaptive management of the proposed IPM.

- The BLM should conduct or fund a study of non-pesticide use IPM methods relative to pesticide use effectiveness. The study should be tailored to determine the various production implications of these two approaches.

To be kept informed of actions minimizing or avoiding adverse effects, or those that benefit listed salmon and steelhead or their habitats, NOAA Fisheries requests notification of the achievement of any conservation recommendations.

Reinitiation of Consultation

Consultation must be reinitiated if: (1) The amount or extent of taking specified in the incidental take statement is exceeded, or is expected to be exceeded; (2) new information reveals effects of the action may affect listed species in a way not previously considered; (3) the action is modified in a way that causes an effect on listed species that was not previously considered; or (4) a new species is listed or critical habitat is designated that may be affected by the action (50 C.F.R. 402.16).

Monitoring data showing that pesticide residues exceed thresholds within the terms and conditions of this Opinion, are an example of new information that would require reinitiation.

If the BLM fails to provide specified monitoring information by November 15 of each year (excluding 2004), NOAA Fisheries will consider that a modification of the action that causes an

effect on listed species not previously considered and causes the incidental take statement of the Opinion to expire. Consultation also must be reinitiated five years after the date this Opinion is signed. To reinitiate consultation, contact the Oregon State Habitat Office of the Habitat Conservation Division of NOAA Fisheries, and refer to NOAA Fisheries No.: 2004/00205.

Incidental Take Statement

Section 9(a)(1) and protective regulations adopted pursuant to section 4(d) of the ESA prohibit the taking of listed species without a specific permit or exemption. Among other things, an action that harasses, wounds, or kills an individual of a listed species or harms a species by altering habitat in a way that significantly impairs its essential behavioral patterns is a taking (50 C.F.R. 222.102). Incidental take refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 C.F.R. 402.02). Section 7(o)(2) exempts any taking that meets the terms and conditions of a written incidental take statement from the taking prohibition.

However, the incidental take statement included in this conference opinion does not become effective for LCR coho salmon until NOAA Fisheries adopts the conference opinion as a biological opinion, after the listing is final. Until the time that the species is listed, the prohibitions of the ESA do not apply.

Amount or Extent of the Take

Individuals of LCR Chinook salmon, UWR Chinook salmon, LCR steelhead, UWR steelhead, and LCR coho salmon will be present in the action area during part of the year when actions necessary to carry out the Horning Seed Orchard IPM are likely to release pesticides that will travel into streams and rivers occupied by ESA-listed species and their prey. As discussed in the biological opinion, pesticides released into those streams are reasonably likely to injure or kill some juvenile salmonids and their prey through a combination lethal and sublethal effects that will continue while the Horning Seed Orchard IPM is in effect and pesticide use is part of that program.

Because such pesticide releases are likely to injure or kill individuals of these ESA-listed species, incidental take is reasonably certain to occur. However, the relationship between habitat conditions and the distribution and abundance of salmonids in the action area is imprecise, as is the exact type, amount and timing of the pesticides that are likely to be released, such that a specific number of individuals likely to be taken cannot be practically obtained. In these circumstances, NOAA Fisheries uses the causal link established between the activity and a change in habitat conditions affecting the species to describe the extent of take as a numerical level of habitat disturbance.

In this case, the extent of take for this incidental take statement is limited to that which will result from detection of any pesticide concentration in the water column shown by the 'low trigger' and 'high trigger' values presented in Table 18 below. (For monitoring details, see page

77.) These indicators and their estimated values were selected using the best available scientific information on the effects of acute toxicity on ESA-listed salmon.

The 'low trigger' values refer to concentrations in flowing water that may be exceeded for one compound, one time, during each of the three annual precipitation and application 'zones' as described in the biological opinion. Thus, a total of three annual exceedences of the 'low triggers' are allowed, one during each period. The 'high trigger' values are concentrations at which acute lethal take is likely to occur and are the maximum extent of take authorized by this opinion. Any observed concentration of a compound named here that is greater than a 'high trigger' will exceed the extent of take authorized by this opinion. These 'low trigger' and 'high trigger' values may be revisited annually to incorporate any significant new information regarding baseline conditions and the lethal or sublethal effects of pesticides on salmonids.

Table 18. Extent of incidental take anticipated to result from completion of the Horning Seed Orchard IPM quantified as pesticide concentrations in the water column.

Compound	Chemical Family	Low Trigger (PPB)	High Trigger (PPB)
Chlorpyrifos	Organo-phosphate	0.15	1.5
Dimethoate		310	3100
Diazinon		4.5	45
Permethrin	Pyrethroids	0.4	3.5
Esfenvalerate		0.0005	0.045
Propargite	Organo-sulfite	5.9	59
Trichloropyridnol (Triclopyr and chlorpyrifos degradate) picloram	Pyridine derivatives	75	750
Chlorothanil	Chlorinated-benzene nitrile	2.1	21

In the accompanying Opinion, NOAA Fisheries determined that this level of anticipated take is not likely to result in jeopardy to the species. Moreover, the habitat that will be affected is not unique and does not appear to be limited on a watershed scale or site-specific basis. The extent of habitat affected by the action is the threshold for reinitiating consultation. Should any of these limits be exceeded during project activities, the reinitiation provisions of this Opinion apply.

Reasonable and Prudent Measures

Reasonable and Prudent Measures are non-discretionary measures to avoid or minimize take that must be carried out by cooperators for the exemption in section 7(o)(2) to apply. The BLM has

the continuing duty to regulate the activities covered in this incidental take statement where discretionary Federal involvement or control over the action has been retained or is authorized by law. The protective coverage of section 7(o)(2) may lapse if the BLM fails to exercise its discretion to require adherence to terms and conditions of the incidental take statement, or to exercise that discretion as necessary to retain the oversight to ensure compliance with these terms and conditions.

The NOAA Fisheries believes that the following reasonable and prudent measures are necessary and appropriate to minimize take of listed species resulting from completion of the proposed action.

The BLM Shall:

1. Minimize incidental take by ensuring that orchard pests are managed using integrated pest management techniques that use treatment thresholds and minimize the need for pesticide application.
2. Minimize incidental take from pesticide applications by choosing pesticide formulas, timing, place, and manner of pesticide use to minimize the likelihood of delivery to riparian and aquatic systems.
3. Minimize incidental take from fertilizer application by ensuring that fertilizer is applied in a time, place and manner that minimizes the likelihood of delivery to surface and groundwater.
4. Ensure completion of a annual comprehensive monitoring and operations reporting program to confirm this Opinion is meeting its objective of minimizing take from permitted activities.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the BLM must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary and, in relevant part, apply equally to proposed actions in all categories of activity.

1. To implement Reasonable and Prudent Measure #1 (integrated pest management) the BLM shall:

   a. Treatment Thresholds. Ensure that no action to suppress insect pests will be taken unless pest monitoring show that one or more pests have reached a threshold at which losses in seed yield and quality exceed the economic and environmental cost of treatment. No pesticide will be applied on a routine basis, without regard for treatment thresholds based on pest populations.

   b. Prescribed Burning. When prescribed burning will be used as a pest control, the following conditions will apply.

i. Design the prescribed burn to minimize disturbance of riparian ground cover and vegetation, and any other habitat characteristic that could be damaging to long-term ecosystem function.

ii. Ensure that all vehicles, including emergency equipment, are not operated, maintained and stored next to any stream, waterbody or wetland. Equipment shall not disturb native riparian vegetation.

iii. Ensure that all vehicles, including emergency equipment, are not fueled within 150 feet of any waterbody.

iv. If riparian areas are inadvertently damaged during a prescribed burn, immediately prepare and implement a rehabilitation plan designed to restore riparian ground cover and vegetation.

v. Appropriate fire suppression equipment shall always be at the project site during a prescribed burn.

c. Each supervisor engaged in IPM activities must be informed of the following requirement:
NOTICE: If a sick, injured or dead specimen of a threatened or endangered species is found, the finder must notify the Vancouver Field Office of NOAA Fisheries Law Enforcement at 360.418.4246. The finder must take care in handling of sick or injured specimens to ensure effective treatment, and in handling dead specimens to preserve biological material in the best possible condition for later analysis of cause of death. The finder also has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not disturbed unnecessarily.

2. To implement Reasonable and Prudent Measure #2 (use of pesticides), the BLM shall ensure that:

a. Spill Prevention Plan and Methods. Prepare and carry out a spill prevention plan to prevent contamination from spill of pesticides and other hazardous materials. The plan will contain the pertinent elements listed below, meet requirements of all applicable laws and regulations, and must be available for inspection on request by NOAA Fisheries.

i. The name and address of the party(s) responsible for accomplishment of the spill prevention plan.

ii. A description of any regulated pesticide and other hazardous materials that will be used as part of the IPM Plan.

iii. Training and certification for those who will be involved with pesticide transportation, storage, use, disposal, record keeping, monitoring, and emergency response.

iv. Practices to prevent spills associated with mixing sites (*i.e.*, containment), critical areas where spills are likely to occur, and environmental restrictions.

v. Spill containment and notification procedures, specific cleanup and disposal instructions for different products, quick response containment

and cleanup measures that will be available onsite, proposed methods for disposal of spilled materials.

b. Timing of Pesticide Application. Time pesticide applications as follows.

i. Prioritize applications for mornings or evenings when pollinators are not active (as seasonally applicable) in accordance with the best overall weather period.

ii. Weather. Pesticides shall not be applied under the following weather and soil conditions unless the product label specifically recommends otherwise.

(1) Within 72 hours of predicted precipitation that would result in runoff and measurable increases in streamflow. To predict this, use a combination of precipitation forecasting, antecedent soil moisture conditions and current streamflows. These methods shall be documented and included in the annual monitoring report.

(2) In areas with standing water and saturated soils.

(3) In unstable air situations that may affect spray pattern or lead to offsite movement of spray, such as high air temperatures, during temperature inversions.

c. Areas of Pesticide Application.

i. Application Buffers. Application methods shall be restricted by zones as follows. Zone widths refer distances from any intermittent or perennial stream or water body with flowing water, measured horizontally from, and perpendicular to, the bankfull elevation, the edge of the channel migration zone, or the edge of any associated wetland, whichever is greater. These buffer widths shall not be decreased over the five-year term of this Opinion.

(1) <20 Feet. Cultural methods, backpack, hand-held wick, injection using the Rodeo® formulation of glyphosate.

(2) >50 Feet. Capsule implantation, hand sprayer, and hydraulic sprayer with handheld wand.

(3) >200 Feet. All of the above, and tractor-pulled spray rig with boom, high-pressure hydraulic sprayer, airblast sprayer, and aerial methods.

3. To implement Reasonable and Prudent Measure #3 (use of fertilizers), the BLM shall ensure that:

a. Fertilizer will not be appliled within 50 feet of any stream, wetland or other waterbody.

b. Fertilizer will be applied at agronomic rates.[18]

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[18] 'Agronomic rate' means a quantity and timing of total nutrient application that does not exceed the requirements of the crop production and harvest or grazing system, as opposed to a nutrient application rate based on production goals that are difficult to define and variable. Calculation of the agronomic rate takes into account the total nitrogen or phosphorus resources for plant nutrition, and any retention of phosphorus in the soil and losses of nitrogen through denitrification and ammonia volatilization.

c. Fertilizer loading (pertaining to application equipment) areas shall be at least 100 feet from perennial streams.

4. To implement Reasonable and Prudent Measure #4 (monitoring and reporting), the BLM shall ensure that:

a. Annual monitoring report. All water quality monitoring information associated with application of the Horning Seed Orchard IPM program shall be compiled, analyzed, documented, and reviewed on a 'water year' basis. This 'water year' shall include all monitoring performed during the October 1 to September 30 period. This information, along with any recommendation for adjustments to protection measures and adjustments to the monitoring plan, shall be contained in an Annual Horning Seed Orchard Monitoring Report. This report shall be available to the public and regulatory agencies on November 15 of each year and be on file at the Horning seed orchard. This report shall include the following information:

i. Project Identification.
- (1) BLM contact person.
- (2) Pesticide project manager.
- (3) Starting and ending dates for work completed.

ii. IPM Documentation.
- (1) Description of how treatments were based on weather and pest monitoring.
- (2) A description of the biological and cultural pest controls used before pesticides were applied, or the reasons that biological and cultural controls were not used. Note that this provision is applicable to initial decisions to apply pesticides in response to pest population levels, not each individual application, and shall be documented within the annual monitoring report.

iii. Pesticide Use History.
- (1) Type of chemical applied.
- (2) Date of application.
- (3) Buffers present.
- (4) Method of pesticide application.
- (5) Total area treated.
- (6) Amount of pesticide applied.
- (7) Precipitation for the three days preceding and following application.
- (8) Wind direction and speed, relative humidity, air temperature at time of application.
- (9) Location used for mixing and loading and notes regarding whether any leakage or spills occurred.

iv. Effectiveness Monitoring.

(1) Orchard units or treatment areas within 200 feet shall have drift cards placed at a maximum of 50-foot intervals along the edge of Horning's unit before the application (for aerial, airblast and high pressure hydraulic sprayer applications), whenever liquid pesticides are applied. Applications shall cease if there is any indication that chemicals are moving out of the target area.

(2) If open canopy occurs in the waterway buffer, drift cards shall be selectively placed along the waterway edge to characterize potential intrusion of drift toward waterways. Any applications shall cease if there is any indication that there is off-target delivery occurring.

v. Surface Water Monitoring to Detect Drift.

(1) For aerial, airblast and high-pressure hydraulic sprayer applications of chemicals, water samples shall be collected before and after spray application that include representative '15 minute' and 24-hour (composite)' post treatment water samples.

(2) Surface water samples are collected within the project area, also, where appropriate, collect water samples concurrently where flowing water enters the project area to facilitate a baseline/cumulative concentration analysis.

Surface drift monitoring shall occur for the following compounds that are applied using these specific methodologies:

Application Method	Compound	Surface Water Drift Monitoring
Aerial	Esfenvalerate	A representative stream[19] or streams will be sampled and tested for each application
Airblast Sprayer High pressure hydraulic sprayer High pressure hydraulic sprayer w/ handheld wand	Esfenvalerate Chlorpyrifos Permethrin Diazinon Dimethoate Propargite Chlorothalonil	Surface water sampling and testing for each application within 300 feet of surface water
Backpack Sprayer - Hand-held wand	Esfenvalerate	Surface water sampling and testing for each application within 100 feet of surface water

vi. Cumulative Concentrations Runoff.

[19] A representative stream is any stream beside a spray unit, downwind of a spray unit, or otherwise likely to be affected if dirft outisde the treatment units occurs.

(1) Stormflow with the highest potential for chemical presence shall be sampled and, during these flow events, samples shall be composited according to the rise and fall of the hydrograph.
(2) SPMDs shall be deployed to sample initial winter storms and spring storm periods after pesticide application.
(3) The SPMDs shall be tested for those pesticides that were applied that can be accurately sequestered.
(4) SPMDS shall be strategically deployed in timeframes that are representive of potential exposure scenarios, such as runoff from significant rain events and or drift during application. SPMDS shall be deployed for approximately 30 days, though smaller time increments are encouraged because they are more sensitive to pulses of pesticides.

Horning monitoring locations for runoff and SPMD placement shall be at the following sites.

Sites related to surface runoff	**Sites related to SPMD placement**	**Sites related to tile monitoring**
Section 23; (site 9c) Ph-2, beside I-33 I-33 B-51 P-32	Section 23, above and below the SPMD B-51 I-33 Ph-2 beside I-33	B-12 B-14 (tile site 3) I-33 I-10 (tile site 2) Control (tile site 1)
Section 23; (site 11a) I-12 I-11 I-33 Ph-2 I-10	Section 13 SPMD: Stream 5 and 2. B-30, B-11, B-50, B-15, B-12, B-14	

Note: For Orchard Unit numbers referenced above, see page 85 and 86 of the Horning Biological Assessment.

vii. <u>Monitoring of Best Management Actions</u>. For select sites, monitoring shall be used to validate the water quality modeling predictions presented in the EIS and BA.
(1) Monitoring of stream 9c shall identify the effectiveness of protection measures, and to help to gauge the estimates in the RA.
(2) Concentrations shall be compared with modeled results utilizing field- and climate-specific data to validate RA estimates.
(3) If detectable concentrations are found, stream concentrations shall also be compared to model results using actual application information, field-specific data, and continuous climate record. These data shall provide a relationship between previous monitoring results and the management that is planned for the future. Once the yearly application period is complete, the climate record collected during that period shall be used to model a predicted concentration using the GLEAMS and MOC models.

These concentrations shall be 'diluted' using the continuous flow data from the station. The resulting concentrations shall be compared with the actual measured concentrations for each storm event sampled.

(4) A collection chamber shall be installed where there is overland flow in unit P-11. During the first overland flow event following select chemical applications, this site shall be visited, and a water sample taken from the collection chamber, these data shall be used to assess the mobility of chemicals that have been used on-site within the past year.

viii. Spill Monitoring. In the event of a chemical spill, the volume of spill, proximity to water, and chemical characteristics, such as toxicity and mobility, shall be immediately evaluated to determine if water sampling is desirable and necessary. If the spill occurs in an area that is reasonably certain to deliver to surface waters, either immediately, or on the next precipitation event, sampling shall occur, as appropriate.

(1) Water samples shall be collected in a sufficient number and at surface water and groundwater locations that shall allow characterization of impacts and effective remediation methods. Depending on ODEQ Monitoring Hazardous Substances Remediation Rules (OAR 340-122), monitoring could include surface water, groundwater, air, and soil.

ix. Groundwater Monitoring. The domestic well at Horning shall be monitored for groundwater contamination. These samples shall occur annually, and normally be collected in late summer and handled according to state-certified laboratory instructions.

(1) Groundwater monitoring wells associated with the greenhouse effluent field shall be monitored. Water quality sampling shall be conducted when risks are highest for irrigation water to potentially reach the local ground water table. If 'point in time' samples are found to have detectible levels of the pesticide, SPMD's shall also be deployed in selected wells toallow a more quantitative determination of concentration over time.

(2) Notification of Discharge. If a surface water discharge occurs, the BLM shall notify NOAA Fisheries within 10 business days of detection. Notification shall include the type, location, and concentration of the discharge.

x. Circumstances that would trigger reinitiation:

(1) More than one discharge per zone, as defined in this Opinion, between the 'low trigger' and high trigger; values (within any one year). Note that discharges below the low trigger value are not applicable to this total.

(2) A discharge within any one year above the 'high trigger' value.

(3) For compounds with a common mode of action (i.e. pyrethroids and organophosphates), if the sum total of the toxic units is >0.05 (equivalent to 1/20th of the standardized LC50's) it will be counted as a 'low trigger' exceedence. If the sum total of the toxic units is > 0.5 (equivalent to ½ of the standardized LC50's) it will be counted as a 'high trigger' exceedence. This applies only when both detections occur in the same location, and at the same time (the compounds co-occur in the water column). The toxic units for each class, pyrethroids, and organophosphates, will be calculated as outlined within this Opinion. Only one 'low trigger' exceedence will be counted if there is a toxic unit 'low trigger' exceedence for a particular chemical family that contains a 'low trigger' exceedence of an individual compound within that same chemical family.

(4) To account for the synergistic action of pyrethroids and organophosphates, as described within this Opinion, an exceedence of a 'low trigger' of both a pyrethroid and an organophosphate (either individually or as a sum total of family toxic units) will be considered the equivalent of exceeding a high trigger. This applies only when both detections occur in the same location, and at the same time (the compounds co-occur in the water column), and includes SPMD data.

(5) Upon any SPMD detection, the data shall be used to provide a 24-hour average waterborne contaminant concentration for the chemicals that were applied and can be sequestered. To reflect the margin of error within the SPMD methodology, a 2-fold safety factor (Huckins 2004) shall be applied to the back calculated 24-hour average concentration (multiply the value by two). The corrected 24-hour concentration shall then be treated as a discharge within the final monitoring plan and the same circumstances apply for reinitiation.

(6) An annual review of SPMD data collection, data use, and sampling methodology may occur. In the event of a detection, factors leading to the resultant discharge concentration shall be reviewed.

c. <u>Annual Operation Report</u>. The Annual Operation Report will be submitted to NOAA Fisheries by December 1st, and include the following information (NOAA Fisheries will review the Annual Operation Report within 30 business days of its receipt, note that the annual operations plan for 2005 only needs to include data specified within number (5)):

i. The results of the previous year monitoring program. If a discharge occurred during the previous year, possible causes of the discharge shall be explored, as well as future mitigation steps to prevent like discharges in the future.

ii. A data review of the pesticides that are proposed for use, or may be used, at Horning in the following year. The review shall include:

(1) New scientific data regarding non-target fish species effects or environmental fate.

(2) Changes to EPA-approved labels (ESA-approved and other).

(3) A review of legal findings relevant to the use of pesticides.

(4) A plan for proposed pesticide applications for the following year, including, to the extent possible, units or acres to be treated, proposed pesticide, application rate and method, dates, and a proposed monitoring plan covering the locations and pesticides to be monitored.[20]

(5) Any proposed changes to the IPM, including new limitations, protection measures, or mitigation measures as part of an adaptive management approach; the use of pesticides in addition to those proposed; or other relevant information.

(6) The annual report shall be sent to:

State Director
NOAA Fisheries
Oregon Habitat Branch
Attn: Michael P. Tehan
525 NE Oregon Street
Portland, OR 97232

d. Annual Coordination. Meet with NOAA Fisheries by January 15, each year as necessary, to discuss the annual monitoring report and any action necessary to make the program more effective.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Background

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2)).
- NOAA Fisheries must provide conservation recommendations for any Federal or state action that would adversely affect EFH (§305(b)(4)(A)).

[20] The draft monitoring plan shall include specific proposed sampling locations, frequencies, and methods in relation to the application plan.

- Federal agencies must provide a detailed response in writing to NOAA Fisheries within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NOAA Fisheries EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: 'Waters' include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; 'substrate' includes sediment, hard bottom, structures underlying the waters, and associated biological communities; 'necessary' means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and 'spawning, breeding, feeding, or growth to maturity' covers a species' full life cycle (50 C.F.R. 600.10). Adverse effect means any impact which reduces quality and/or quantity of EFH, and may include direct (*e.g.*, contamination or physical disruption), indirect (*e.g.*, loss of prey or reduction in species fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 C.F.R. 600.810).

EFH consultation with NOAA Fisheries is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities.

The objectives of this EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH.

Identification of EFH

Pursuant to the MSA, the Pacific Fisheries Management Council (PFMC) has designated EFH for three species of Federally-managed Pacific salmon: Chinook and coho salmon (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other waterbodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC 1999), and longstanding, naturally-impassable barriers (*i.e.*, natural waterfalls in existence for several hundred years). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the *Pacific Coast Salmon Plan* (PFMC 1999). Assessment of potential adverse effects to these species' EFH from the proposed action is based, in part, on this information.

Proposed Actions

The proposed action and action area are detailed above in this Opinion. The action area includes habitats that have been designated as EFH for various life-history stages of Chinook and coho salmon.

Effects of Proposed Action

As described in detail above, the proposed action may result in short- and long-term adverse effects to habitat due to adverse alteration of water quality.

Conclusion

NOAA Fisheries concludes that the proposed action may adversely affect designated EFH for Chinook and coho salmon.

EFH Conservation Recommendations

Pursuant to section 305(b)(4)(A) of the MSA, NOAA Fisheries is required to provide EFH conservation recommendations to Federal agencies regarding actions which may adversely affect EFH. The terms and conditions outlined in this Opinion are generally applicable to designated EFH for Chinook, and coho salmon and address these adverse effects with the exception of monitoring requirements (RPM 5). Consequently, NOAA Fisheries recommends that they be adopted as EFH conservation measures.

Statutory Response Requirement

Pursuant to the MSA (§305(b)(4)(B)) and 50 C.F.R. 600.920(j), Federal agencies are required to provide a detailed written response to NOAA Fisheries' EFH conservation recommendations within 30 days of receipt of these recommendations. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity on EFH. In the case of a response that is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

Supplemental Consultation

The BLM must reinitiate EFH consultation with NOAA Fisheries if the proposed action is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 C.F.R. 600.920(k)).

DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law106-554) ('Data Quality Act') specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these Data Quality Act (DQA) components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

Utility: This ESA section 7 consultation on the proposed programmatic Integrated Pest Management program at the Walter H. Horning Seed Orchard in Clackamas County, Oregon concluded that the action will not jeopardize the continued existence of LCR steelhead, LCR Chinook salmon, UWR steelhead, UWR Chinook Salmon, or LCR coho salmon, a species proposed for listing under the ESA. Pursuant to the MSA, NOAA Fisheries provided the BLM with conservation recommendations to conserve EFH.

The intended user of this consultation is the BLM. The American public will benefit from the consultation.

This consultation will be posted on the NOAA Fisheries Northwest Region web site (http://www.nwr.noaa.gov). The format and naming adheres to conventional standards for style.

Integrity: This consultation was completed on a computer system managed by NOAA Fisheries in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

Objectivity:

Information Product Category: Natural Resource Plan.

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NOAA Fisheries ESA Consultation Handbook, ESA Regulations, 50 C.F.R. 402.01 *et seq.*, and the MSA implementing regulations regarding EFH,50 C.F.R. 600.920(j).

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the literature cited section. The analyses in this biological and conference opinion/EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NOAA Fisheries staff with training in ESA and MSA implementation, and reviewed in accordance with Northwest Region ESA quality control and assurance processes.

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